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NOTES.

Municipal Trading.

It would seem that we are nearing a crisis as regards municipal electricity undertakings and the contractor. A very militant feeling prevailed among members of the Municipal Electrical Engineers' Association at the Glasgow meeting, and matters have not been improved by the set-back at Leicester. Two lines of argument are advanced. It is contended that as many such undertakings already possess Parliamentary powers not only to carry out wiring, but to let on hire or sell appliances, all others should be placed on the same footing, and practically levelled up to the position of Electricity Supply and Gas Companies. Advocates of this line of reasoning are strongly in favour of an appeal to Parliament, by way of an Amendment Bill on the Electric Lighting Acts. Others point out that an immense amount of spade work has to be undertaken in order to bring home to the community the advantages of electricity. As Mr. Seabrook said, after 25 years' working in St. Marylebone, only 40% of the houses in the borough have electric supply, and some of these use current as an auxiliary, or treat it as a standby. Much the same may be said elsewhere, whether the district is supplied by a company or corporation.

A Policy of "Push" Necessary.

This shows that a policy of pushing and advertising is necessary. Now, we know that when the gas companies began to feel the pinch of electric competition, they went on the war-path, offering all kinds of facilities to customers, including the hiring and installation of heating, cooking and other apparatus. They made a striking display of such gas consuming apparatus either at their offices or in specially hired shops. And the policy undoubtedly paid, and is paying. It is not altogether to be wondered at that the electricity undertakings desire to follow in the footsteps of their enemies, and even "go one better." The accusation against the average run of contractor is that he is not enterprising. He does not push latest systems or new appliances. The public knew little about electric fans, radiators, cookers, irons and so on until the supply companies took the matter up and brought these requirements under the notice of their customers. In many ways it is a great pity that such rivalry should exist, but it is inevitable, and it behoves the contractors as a body to "Wake Up" and show the municipalities that they can beat them at their own game. The better they succeed, the better everybody will be pleased.

Unfair Trading Argument.

Some people write and talk about "unfair trading," urging that it would be "more dignified to have supplied electricity up to the consumers' premises, instead of attempting to secure the trade of installing and fitting inside the premises." But the object is not to secure a trading profit in this direction—although good managers, of course, desire the department to pay its way—the endeavour is to increase the demand for current by first-rate and economical fittings and useful current-consuming appliances. It is a growing outlet for supply that is wanted, and the municipalities, like other supply authorities, are merely anxious to that end. The question is how best to do this? The municipalities, as a whole, roundly say they must take the matter up, because the electric contractors lack energy and enterprise, whereby the supply undertaking suffers. Again, the contractors must "Wake Up," directing their efforts to making themselves indispensable, rather than attempting to suppress the work of others.

A Genuine Grievance.

A grievance of quite another character has again cropped up at Grimsby, where the local branch of the Electrical Contractors' Association has complained that certain employees of the Corporation's Electricity Department were in the habit of canvassing in their spare time among electrical consumers to carry out work. It is alleged that the work was done at rates of wages which were little more than pocket money rates, and yet contracts up to £30 had been taken. This is not as it should be, and at a previous meeting of the Electricity Committee it had been decided to put a stop to the practice. Apparently, however, the competition continued, for the Association again complained. By way of defence, it was said that the charges were vague and extravagant, but the discussion was practically stopped. This is a great pity, if the complaints are exaggerated this ought to be proved; if they are not, then a remedy should be found at once. A scandal of this kind should be met openly.

Electricity on the Rand.

Johannesburg is certainly just at present the centre of an electric storm of considerable dimensions and potentialities. There is a struggle going on between the Municipality and the Victoria Falls and Transvaal Power Co., Ltd., for what practically amounts to a monopoly in this great mining region. The *British and South African Export Gazette* speaks out plainly on the subject, roundly declaring that no body, public or private, "should be permitted to stand in the way of industrial progress by charging a rate for electrical energy beyond its fair market value, and if it attempts to do so, it should be within the power of the authorities to sanction the introduction of competition. This, indeed, is the general object of the Bill, and so far it would seem to be unassailable. There has apparently been an attempt at compromise between the Power Co. and the Municipality, the former offering to consent to the insertion in their license of a clause binding them not to supply power within the municipal area except (1) to mines, (2) to Government Departments, and (3) to industrial consumers requiring power to a minimum amount of 130 h.p., unless the consent of the municipal authorities is obtained; but this has not been accepted, the interests of the taxpayers of Johannesburg, who have invested £500,000 in a power department, being urged against such a proposal."

The British Interest.

Our contemporary, we think, takes the right point of view, and passing over minor details, continues: "Looking at the underlying inferences, however, rather than at the squabble itself, the gigantic nature of the Rand's electrical requirements, municipal and industrial, stand revealed, and however the dispute is eventually settled, the progress of electrical undertakings in the district will be bound to proceed at an unabated rate. In the mines the utilisation of electrical energy both above and below ground in regard to some of the largest installations in existence, and the application of electricity to an increasing number of accessory industrial enterprises, has built up a business for the supply of machinery and materials which is second to none in the world. The only pity is that, as we pointed out last month, British manufacturers are not so much to the fore in the matter of feeding this enormous market as might be desirable. There is the practical certainty, too, that if a monopoly of any sort, and particularly one in which foreign capital is interested, were to be established, the British position would be still more hopeless. The interests of English manufacturers undoubtedly lie in the passing of the Power Bill."

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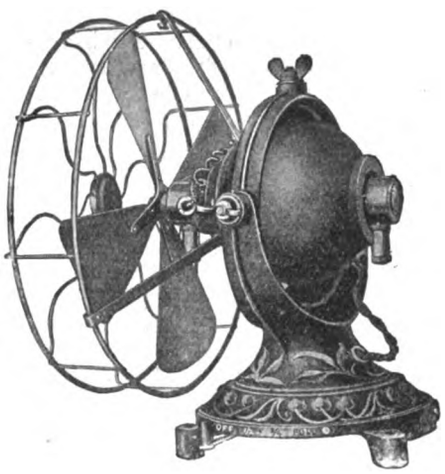
Electricity in the Summer Time.

Third Article.—FANS—*continued.*

THE ELECTRIC ORDNANCE ACCESSORIES CO., LTD., Acton, Birmingham.

Apart from careful design and good workmanship the fans of this firm may be noted for being fitted with anti-friction metal adjustable and self-oiling bearings, and also for the fact that all parts are made to gauge,

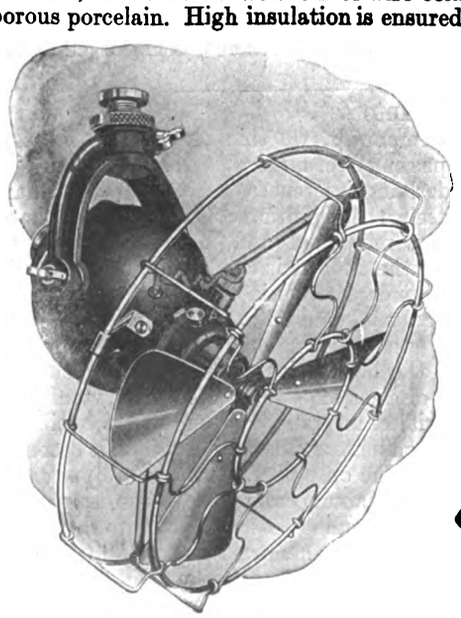


E.O.P's. "A.P." DESK FAN.

are interchangeable and spares can easily be supplied in the event of damage. The A.P. type may be used as a desk or wall fan, or with special fittings as a ceiling fan. The pedestals are provided with rubber cushions to mitigate vibration. For ships' cabin use a special fixing plate has

E.O.P's. SHIPS AND RAILWAY FAN.

been designed, which enables the fan to be moved about at will. The combined switch and three-speed regulator is fitted inside the base, the resistance consists of wire coils wound on net porous porcelain. High insulation is ensured. These

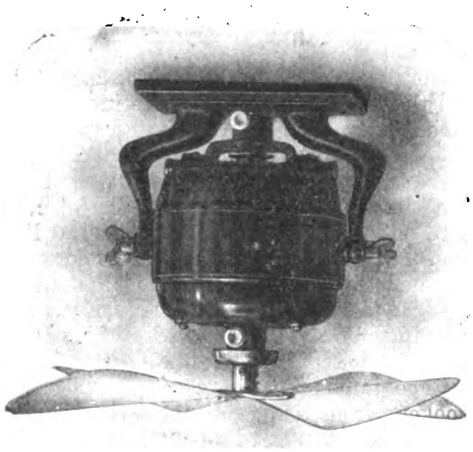


E.O.P's. "A.P." FAN WITH DEVICE FOR FIXING TO CEILING OF CABIN, &c.

fans for D.C., and of voltages ranging from 60–80, 100–120 to 200–250, are made in two sizes: 12 in., consuming approximately 45 watts, and costing £2 8s. 9d., and 16 in., consuming 60 watts, costing £3. The A.C. 12-in. desk fan, fitted with swivel and trunnion, with an approximate consumption of 80 watts costs £3 2s. for 24–130 volts, and £3 5s. 6d. for 150–230 volts, while the 16-in. fans, consumption 140 watts, cost respectively £4 3s. 6d. and £4 6s. With bracket fittings the prices are enhanced by a few shillings. The Pedestal Fan, both for D.C. and A.C., are rather lower in price. From among the large variety of D.C. and A.C. ceiling fans we select the very neat ships' saloon and railway carriage D.C. fan, with two short aluminium blades, having a sweep of 26 in., set at an angle of 15°. These are priced at £3 5s. A very similar pattern, but with wooden blades, having a 40 in. sweep, costs £3 2s. 6d.

HOGAN & WARDROP, Gloucester Mansions, Charing Cross-road, London, W.C.

This firm has made a speciality of quite small electric motors—the efficiency of their design and manufacture is well seen in the smooth running of their fans, whether of the desk and bracket type, ceiling or porthole. All these are made for D.C. and for A.C. single and three-phase. All parts have high insulation. The armature and coil windings are covered with double cotton and double silk, and the bearings of the motors are not only made of anti-friction metal, but adjusted to take up wear, so they are noiseless from beginning to end. Moreover, lubrication is automatic and the A.C. motors are of the induction type, doing away with all possible brush and commutator



trouble. Repulsion types are also made for low periodicities. Another great feature is that all parts are interchangeable. Now as to the appearance of the different patterns. We have desk fans with solid bases, desk fans with swivel and trunnion fittings for adjustment of angle, and bracket fans also with swivel and trunnion attachment. These blades, slightly curved, of 9½, 12 and 16 in. diameter for D.C. fans, and 9½ in. for A.C. single-phase and 12 and 16 in. for A.C. single and three-phase. In the D.C. types the regulating resistance placed in the base

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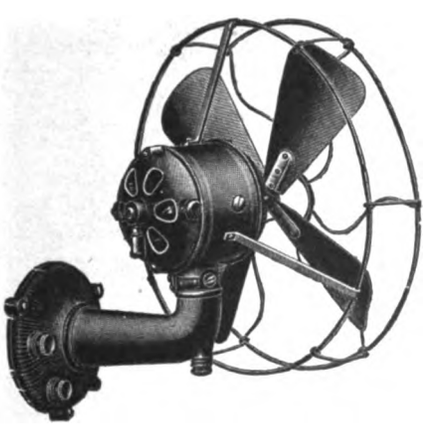
give three speeds and an "off" position; in the smaller A.C. single-phase fan, we find a switch and only one speed available, but the other sizes have regulators with two speeds and an "off" position. They are solidly built, but have an elegant appearance, and are thoroughly economical. For instance, a D.C. solid base desk fan of 9½ in. in diameter, running at 1,600 r.p.m. and capable of moving 550 cubic ft. of air per minute costs £2 14s. for a 24–130 volts machine, or £2 17s. for a 150–230 volts size. The larger size, 16 in., running at 1,500 r.p.m. and moving 1,800 cubic ft. of air per minute costs £4 and £4 4s. in the respective voltages. On the other hand, a small single-phase A.C. fan running at 1,200 r.p.m., and moving 425 cubic ft. of air per minute costs £3 7s. and £3 10s. for the two voltages, and the 16-in., with a speed of 1,350 and a capacity of 1,600 cubic ft. of air, costs £4 16s. and £4 18s. The swivel and trunnion attachment entails the addition of a few shillings, and bracket patterns are slightly higher. High speed fans, such as we have just described, but with rather larger motor cases are fitted as ceiling fans, pendant direct from a base and swivel and trunnion attachment, or from a long down rod. The regulation slow speed ceiling fans have long polished wood blades, slightly curved and set at an angle. A novel design is the D.C. ceiling fan without down rod, which can be fitted with ordinary horizontal or upturned blades, as shown in the diagram. These fans, with a sweep of 28 in., speed 325 r.p.m., and a consumption of 35 watts costs £3 5s. for a 24–130 volt machine, and £3 15s. for a 150–220 volt fan. Aluminium blades can be substituted at an extra cost of 2s. A slightly plainer pattern, known as "Ship," sells at a few shillings less. Various patterns of ceiling fans with down rods are made for both D.C. and A.C. A very fine pattern for large premises is the 60 in. two-blade ceiling fan. In the D.C. machine it runs at 225 r.p.m., consumes 100 watts, and costs £7 6s. for 24–130 volts, and £8 for 150–220 volts; while in the A.C. pattern at 50 periods, it runs at 200 r.p.m., consumes 200 watts, and costs respectively £9 12s. and £9 14s. These A.C. fans have a range of between 40 and 60 periods. It will be seen that Messrs. Hogan & Wardrop give their clients plenty of scope for choice.

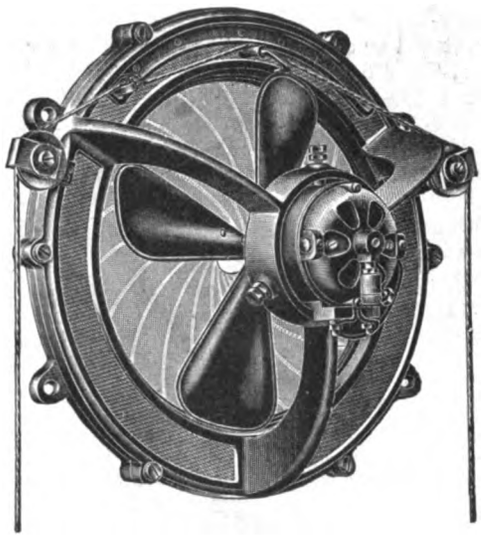
Siemens Bros. Dynamo Works, Ltd., Caxton House, Westminster, S.W.

It will be seen from the accompanying illustration that the Siemens fans are unobstrusive in appearance and of very effective design, the four blades being just of the right shape to produce a good current of air whether run slowly or swiftly. The continuous current fans are made in two types: with rigid base for table use (five sizes



Knuckle Joint Bracket Fan.

ranging from 6 to 220 volts and in price from 18s. 6d. to £2); and with knuckle joint, for use as table or as bracket (four sizes, ranging from 110 to 220 volts and in price from £2 3s. to £2 16s.). They are economical running fans, carefully made throughout. Alternating current motors are fitted to fans on demand. Messrs. Siemens also make continuous current porthole fans, with four scooped-paddle blades, the protected or totally enclosed motors being supported by flat arm tripods, specially designed to reduce vibration. They are made in many sizes, varying

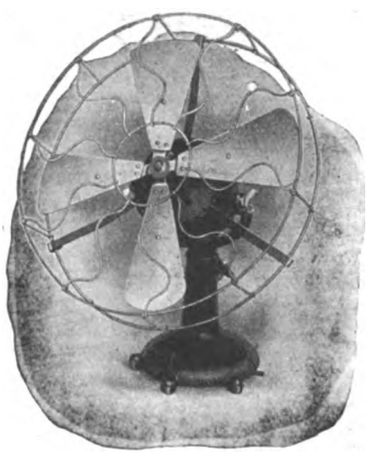


Porthole Fan with "Iris" Shutter.

in voltage from 110 to 500, and in price from £2 6s. 6d. to £26 14s. 6d. A notable feature of these fans is that they can be fitted with frames, enclosing adjustable Venetian or Iris shutters, by which the direction of the current of air may be distributed and directed.

The Sun Electrical Co., Ltd., 118-120, Charing Cross-road, London, W.C.

The art of ventilating by means of air propulsion has been studied to some purpose by this firm, who place on the market a great variety of table, bracket and ceiling fans. Among the D.C. apparatus we select for illustration a swivel and trunnion table fan, fitted with universal joint to enable it to be converted into a bracket type, It will be noticed that the four blades are of good design. In the base is a three-speed controller. This pattern is made in four sizes, two of 12 in. in diameter respectively, 65-100 volts and 200-250 volts, costing £2 7s. 9d. and £2 10s.; and two of 16 in. diameter, of the voltages as



No. D516.—Swivel and Trunnion Table Fan.

above and costing £3 2s. 6d. and £3 5s. 9d. A more expensive pattern of the above, with larger motor and shorter base pillar, runs to £3 3s. The A.C. fans are made either with rigid base for desk use, or with swivel and trunnion fittings for converting into bracket fans. The motor cases are rather larger and flatter than the D.C. machines, but the fans have a very neat appearance. The motors are of the induction type and are made to suit any periodicity on single-phase circuits. The three patterns—rigid base, wall bracket and convertible, are made in eight sizes, ranging in voltage from 100-110 to 20-220 and in price from £2 8s. 6d. to £4 2s. A type that has much to recommend it, is the novel lampholder fan, two patterns of which are illustrated, made for D.C. and for A.C. up to 60 periods. These fans have four curved 6 in. blades. The ordinary standard pattern is fitted with screw or bayonet cap. The D.C. pattern of 100 volts costs £1 5s. and 200-240 volts £1 8s.; while the 100 volts A.C. costs £1 11s. 6d.

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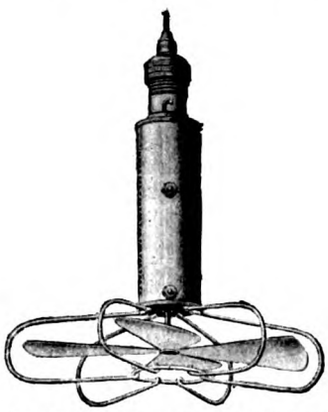
and the 200-240 volts £1 15s. 6d. The table fan also illustrated is, it will be seen, capable of considerable regulation of angle: the 4-6 volt D.C. fan costs £1 5s., 100 volts £1 8s., and 200-240 volts £1 11s. 6d.; A. C. 100 volts £1 15s., 200-240 volts £1 18s. 6d. Another modification is the fitting of a new swivel and trunnion arrangement for suspension fans, this enabling the air to be thrown in



ORDINARY STANDARD FITTED WITH SCREW OR BAYONET CAP.

any direction, while provision is made to prevent the motor turning round. Here also we have five sizes, the three D.C. of same voltages as the preceding, costing respectively, £1 8s. 6d., £1 11s. 6d. and £1 15s.; the A.C. £1 17s. 6d. and £2 1s. 6d. We have here, therefore, an

AS A TABLE FAN.

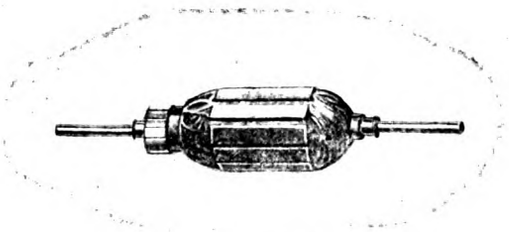
essentially popular fan. Another striking speciality is the "Punkah" fan, the motor being hidden in a brass ornamental Oriental repoussé bowl. The fan blades revolve horizontally, while the polished copper wire cage guard is fitted with a series of deflecting blades, which act as

SUN PUNKAH FAN.

splendid distributors. The D.C. type, voltage 65-250 with 12 in. blades, costs £11, with 12 in. blades £12 15s.; the A.C. type, 100 to 200 volts, 50 to 100 periods single-phase, cost respectively, £12 17s. 6d. and £14 10s. The Sun Co., also make D.C. and A.C. ship-cabin fans, suitable for use on board and on trains. They are either of the fixed type or fitted with swivel and trunnion adjustment. In ceiling fans a good general type is the "White Wings," with two blades, fixed at different angles, and having a sweep of either 26 or 36 in. and costing respectively, from 65-110 volts, £3 5s. 6d., £3 7s. 6d., £4 13s., and £4 15s. 9d. The A.C. ceiling fans are made for slow speed. We must not omit to refer to the useful D.C. revolving or oscillating fan, with adjustable reversing stops; and the oscillating fan base which enables any type of standard D.C. or A.C. fan to be at once converted into an oscillating type. The first-named costs respectively, from 100-120 volts, (12 in. blades), £3 10s. and 200-250 volts £3 15s. 6d., and the base for 12 in. fan, £1 15s., and for 18 in. fan, £2 7s. 6d.

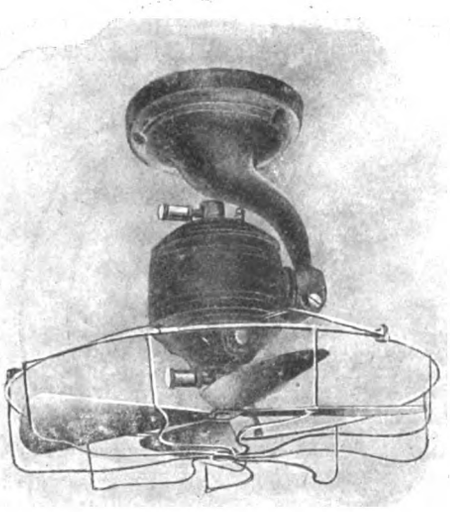
C. A. VANDERVELL & Co., Warple Way, Acton Vale London, W.

With a view to overcome all trouble arising from careless handling and from dust, the Vandervell fan motors are of the totally enclosed type, with all connections to the brushes inside. The armatures are fitted with silk-covered copper coils and moisture resisting cloth, the whole being



C. A. V. ARMATURE.

treated with a waterproof compound and then baked. The commutator is built up of hard-drawn copper segments insulated with mica. The poles of the field magnet are specially designed to ensure noiseless running, and the bearings are self-aligning and fitted with automatic lubricators. The regulating rheostat is mounted on a porcelain



D. C. CEILING AND BRACKET FAN.

plaque, concealed in the fan base, and is provided with three speeds. Many patterns of fans with swivel and trunnion fittings and suitable for both desk and bracket fixing; the convertible pattern, made in voltages ranging from 50-65 to 200-240 and in price from £1 19s. 6d. to £3 12s. is excellent. Another very commendable design is the marine cabin design, suitable for fixing from ceiling or as a bracket. This fan can be adjusted to any angle, but it revolves at a uniform rate. It is made in the same sizes

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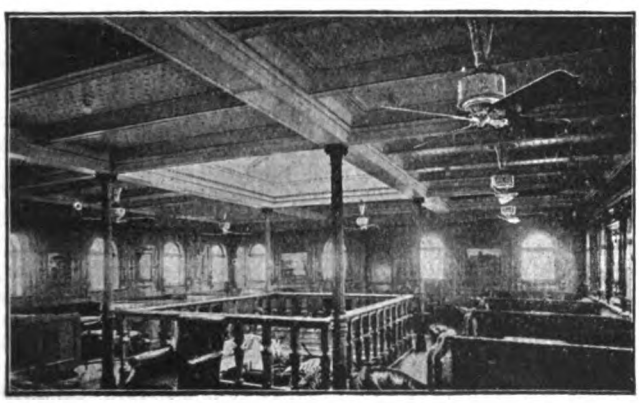
"Dreadnought" Convertible Desk, Ceiling, and Bracket Fans.

as quoted above, but at prices ranging from £1 13s. 6d. to £3 6s. Another design for cabin and similar use is the "Dreadnought," fitted with two helical blades, the motor being swung in a kind of stirrup. It is interchangeable, for fixing on ceiling, wall or table, is made in four sizes, voltages 50-65, 100-120, and 200-240, and ranges in price from £2 3s. 6d. to £3 9s. 6d. Ceiling fans, specially designed for tropical climates, are made in quite a number of patterns, the "Dreadnought" with two helical aluminium blades, and made in five sizes, voltages as above, and prices ranging from £3 15s. to £10 6s.

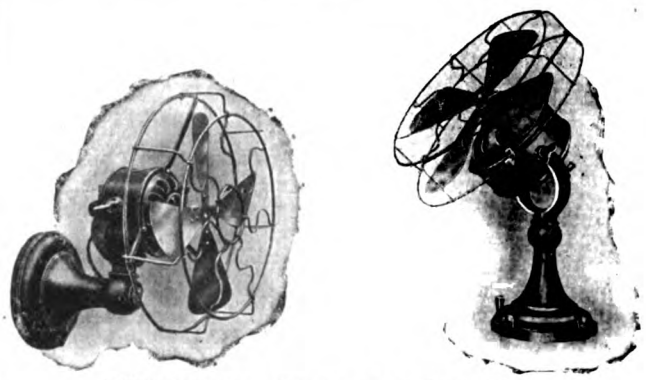
Verity's Ltd., King-street, Covent Garden, London, W.C.

Messrs. Verity have paid particular care to the problem of regulating the speed of ventilating fans and they have perfected five distinct types of regulators adapted for different needs. The "Zephyr," in a small circular case having a projection of only 1⅝ in., is a 60 watt regulator for small D.C. fans. The "Aston" has a rectangular base, with handle and six and one "off" positions; it is suitable for any D.C. ceiling fan up to 18 in. diameter. The "Bengal" is an enclosed type, built up of interchangeable units without wire connections, and is adapted for ceiling and ventilating fans of 120 watts up to 15 in. diameter. The "Imperial" is practically a modified "Aston," but with the handle placed on one side. Finally,



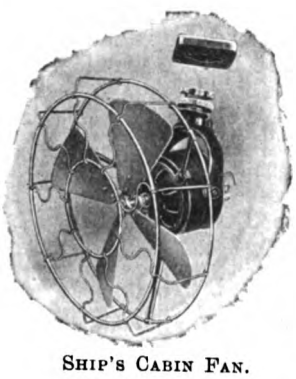
Aston "Typhoon" Fan on R.M.S. "Avon."

the "Columbo" is an A.C. choking coil regulator for ceiling fans. These ceiling fans, by the way, have long been a speciality with Verity's, who make them in many patterns both for use in hot climates and on board ship. We illustrate, for instance, the "Typhoon" fan at work in the Childrens' Saloon on board the *R. M. S. Avon*. This "Typhoon" pattern has four paddle-shaped blades and an ornamental casing for the motor. It has a sweep of 53 in. and a speed of 200 r.p.m. The standard voltages are 100-110 and 200-250 and the prices £8 5s. with four wooden blades and £8 15s. with three aluminium blades. Other patterns are the "Assam," two curved blades, price £4 10s.; "Calcutta," four wooden or three aluminium curved and curly blades, prices from £7 2s. 6d. to £7 10s.; and the "Dum Dum," with two rounded and adjustable blades. All these are made in "Saloon" patterns; that

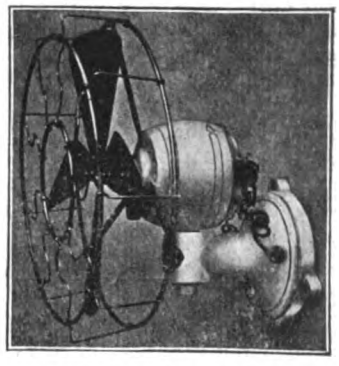


"Typhoons" as Bracket and Desk Fans.

is to say, the long pendant is replaced by a short base or tripod, the motor being close to the ceiling. The "Typhoon" desk and bracket fans are of a very handy type; they have four curved blades, the motor is ventilated and is provided with swivel fittings. A switch with three speeds and "off" is placed on the base. They are made in five



Ship's Cabin Fan.



Railway Carriage Fan.

sizes: 24-32, 50-65, 100-110, 200-220 and 230-250 volts and range in prices from £3 6s. to £4 13s. The ship's cabin fan illustrated is very similar to the above, only the fan is detachable, the motor trunnion fitting into a base plate permanently screwed to the cabin roof. As two or more of these bases can be fitted in a cabin, the position of the fan can be speedily changed, say from over the writing desk to over the bunk or lounge chair. Another modification is seen in the railway carriage fan, provided with substantial bracket and usually fitted with a separate regulator.

PROGRESS IN JAPAN.

H.M. Commercial Attache at Yokohama (Mr. E. F. Crowe) on the trade of Japan in 1909, which will shortly be issued :—

A noticeable feature of the year under review, especially of its closing months, has been the boom in electric tramway and gas undertakings, more particularly for the district round Osaka and Kobe and for the south of Japan. Nearly every day notices appear in the papers of some new charter that has been applied for, and it seems to be no objection at all to a scheme that there should be a rival in full operation a few miles away. Where so many proposals are made it is clear that only a small percentage can be successfully developed, and it is desirable, therefore, that great caution should be exercised before attempts are made to take part in any of these ventures. There are several engineers on the spot whose business it is to watch these enterprises, and, if anything at all good is forthcoming, they know, or ought to know, all about it long before the general public. It is clear, therefore, that most propositions which have been rejected by them could not be described as thoroughly sound, and as in most cases orders for machinery and rolling stock, etc., are accompanied by requests for very easy payments, the business is often not worth much. The above remarks must be taken as referring more particularly to the tramway rather than to the gas schemes.

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DEVELOPMENTS IN TELEGRAPHY AND TELEPHONY.*

By Sir John Gavey, C.B., M.Inst.C.E.

The subject selected by the President and Council for to-night's lecture covers such wide ground that to deal with it comprehensively would require a whole course of lectures rather than a single address.

We may select the ordinary Morse circuit as our starting-point, as by far the largest proportion of the world's telegraphic traffic is still conducted on this system, and, as will be seen later, many of the developments in telegraphic apparatus have been based on the Morse method of signalling.

It is also unnecessary to dwell on the simple form of Morse circuit, which consists of a battery with one pole to earth, a key for making and breaking the contact between the battery and the line, and at the far end of the latter an electro-magnet which records all the movements of the key, further than to point out that the speed of working, even under the best conditions, is limited by the skill of the operator, and that it rarely exceeds 30 words a minute.

For many years this sufficed, but when growth rendered it imperative to erect long lines directly connecting distant cities, the problem of obtaining a greater revenue from the large capital expenditure involved became pressing, and progress was made broadly on three distinct lines of development. In the first, means were designed for the transmission of several messages simultaneously over the same conductor; in the second by the use of suitable mechanical and electrical devices the actual speed of transmission was raised in overhead wires to 10 or 12 times that possible by manual operating, and, finally, type printing and writing systems were invented with varying degrees of success.

Simultaneous Transmission.

The duplex system admits of the simultaneous transmission of two messages in opposite directions over the same wire. At each end of the circuit is a differential receiver which comprises two equally-balanced electro-magnetic coils, one of which is connected at its further end to the line wire and the other to an artificial line which, in its electrical resistance and capacity, is as nearly as possible the equivalent of the actual line. The two inner ends of the magnet coils are connected together, so that when a current is sent from the point of junction it divides equally between the actual and the artificial lines, and the coils being so wound that under these conditions the magnetic effect of one is neutralised by the magnetic effect of the other, the signals originating at either end pass through the home apparatus without affecting it. At the far end, when one station only is signalling the current passes through one coil alone of the receiving apparatus and the signal is recorded. When, however, both keys are depressed simultaneously, if the batteries are so connected that they aid each other (they may either oppose or aid), then it will be seen that the current which circulates through the line wire and through both of the magnet coils connected thereto is doubled, but as the current which circulates through the magnet coils at each station connected to the respective artificial lines is unaltered a signal is recorded because the balance at either end is destroyed by the action of the other operator.

The transition from duplex to quadruplex working, viz., the sending of four messages simultaneously over one wire involved but a step. There are two kinds of electro-magnets in use telegraphically, one provided with a simple soft iron armature which is equally attracted by positive or negative currents, and one provided with an armature which is itself a magnet, and which remains unaffected, or rather is repelled against its limiting stop, by a current that induces in the magnet coils a similar polarity to its own, but is attracted by a reverse current which induces an opposite polarity. Either type of magnet may be used for duplex, but both types are used for quadruplex. The non-polarised magnet responds to a current of considerable strength in either direction, the polarised magnet to a weaker current in one direction only. In practice a single-current key is connected to a powerful battery which is intended to work the non-polarised magnet, but the connections are led through a reversing key, which latter is designed to actuate the polarised magnet. When the single-current key is depressed the powerful current that circulates through the apparatus actuates the non-polarised relay at the far end leaving the polarised relay unmoved. When the reversing key alone is depressed, a weak current circulates which actuates the polarised magnet but is too weak to act on the non-polarised instrument. If both are depressed simultaneously the powerful current from the single-current key is reversed by the depression of the double-current key and both instruments at the far end are affected. The receiving apparatus at each end is arranged differentially as in the duplex system, so that the outgoing currents have no effect on either of the receivers at the home end. This arrangement admits of four operators sending four messages simultaneously over one wire. The artificial lines must be as far as possible the electrical equivalents in resistance and electrostatic capacity of the actual lines, and that means have to be provided for varying these factors, as the actual line itself varies under the influence of weather changes.

Another method, which in theory admits of sending as many as 12 simultaneous messages in one direction, or double that number if duplexed, depends on the superposition of musical vibrations on a telegraphic circuit at one of end a line. To effect this result a number of electrically-driven tuning forks, arranged to vibrate at different frequencies, are connected through telegraphic keys to a line wire, so that on depressing any one key a series of electrical vibrations, of the frequency of its companion tuning fork, are sent through the line. At the far end the receivers are of a type that will respond to musical vibrations only, and each receiver is constructed or adjusted to respond to the vibrations of one of the distant tuning forks alone and to no others. If any one key is depressed a simple musical oscillation traverses the line and the receiver in tune responds. If two or more keys, however, are depressed simultaneously a series of compound curves is transmitted and those receivers that are in tune with the various components of the curves respond and all the others remain unaffected. Originated in America, the system has been developed by Mercardier in France, where it has given good results. In the modern apparatus the receivers consist of so-called mono-telephones, each of which is so made and adjusted as to respond to only one frequency.

A method of multiplex telegraphy based on entirely different principles is the following. The working of the Mercardier system has shown that the electrical conditions of an overhead line admit of a far more rapid transmission of readable signals than is possible by ordinary manual operation, and it has also shown that the continuous currents used in general for signalling dots and dashes may be replaced by intermittent currents which, by suitable means, can be translated at the receiving instruments into the ordinary Morse dots and dashes. This line of reasoning led to the following development. A large number of insulated metallic segments are arranged in a circle at each end of the line and divided into groups, say, of eight each. No. 1 of the first group is metallically connected with No. 1 of all the other groups, and, through the transmitting key, with No. 1 instrument, No. 2 with No. 2 series of contacts and instruments, and so on. Centrally-pivoted arms, provided with metallic brushes which ride over the segments, are joined one to each extremity of the line wire, and it is obvious that if both these arms, starting simultaneously from No. 1, revolve at precisely the same speed, then each segment with its instrument at one end is for a brief period placed in connection with its corresponding segment with its instrument at the distant end. If the sending key of No. 1 instrument is depressed, a brief current is transmitted to its corresponding instrument when the revolving arm reaches No. 1 contact of any group, to be repeated when the arm reaches No. 1 of the next group, and so on throughout the series. Instead, therefore, of a dot being represented by a single current of continuous duration it is replaced by three or four shorter impulses spread over the same period of time, and a dash by three times the number of impulses. By this means it is possible, under favourable conditions, to transmit eight messages simultaneously over one wire. This system, invented by Delaney, was developed to some extent in this country, but has recently been abandoned. It is referred to here as the principle of revolving commutators is in use in other forms of apparatus to be dealt with later

* Abstract of The "James Forrest" Lecture, delivered before the Institution of Civil Engineers, June 22.

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The second method of increasing the output of telegraphic wires is the automatic or machine-transmitting instrument, which is typified by the Wheatstone apparatus adopted and perfected by the Post Office in Great Britain. In all instruments of this character a long paper ribbon is perforated by a suitable machine in an arbitrary manner, and the transmitting and receiving apparatus is so designed as to transcribe these perforations, at the distant end, into Morse signals, into similar perforations, into type printed messages, or even into written characters. The perforated tape, or slip, used in the Wheatstone has three rows of perforations. The centre row is continuous as it is used for drawing the slip through the transmitter at the speed at which the latter is running, the upper and lower holes cause the transmitting key to send electrical signals, dots when these rows are vertical, dashes when diagonal. The actual apparatus which effects this object is comparatively simple. Two small vertical plungers, to which an up-and-down motion is imparted by the clockwork of the apparatus, are pivoted to two bent levers connected by horizontal rods with a small vertical transmitting key which in one position sends a positive and in the other a negative current to line. When no slip is in the machine, the plungers as they rise and fall move the key to and fro and send reversals which are received as dots at the far end. When the slip is inserted, if the plungers meet a series of vertical perforations they pass through at each movement and dots are still transmitted, but if they meet diagonal perforations, the movements of the plungers are arrested by the unperforated portion of the paper slip, and the transmitting key is not drawn back until one of the plungers enters the lower diagonal hole of the slip and withdraws the key from its sending position, thus recording a dash.

This Wheatstone system has been fully developed in the United Kingdom. It is capable of dealing with traffic at a maximum rate of 450 words per minute and it is invaluable for the transmission of news. Thus, in the central office in London, items of news may have to be transmitted to 50 or more towns simultaneously. Circuits are made up for news transmission, each providing for a number of towns, some of the circuits being of a permanent character and some formed temporarily to meet special requirements. Eight Wheatstone slips can be punched simultaneously in one operation and each length of slip is run through the necessary transmitters at the highest speed considered judicious. When long press messages are received they are divided into sections and each section handed to a separate telegraphist for perforating so that the transmitting apparatus can be kept to its maximum capacity. For ordinary public message traffic, on lines of moderate length, where each individual message is short, the Wheatstone has certain disadvantages, namely, the initial delay in perforating the slip, its distribution, and finally the re-distribution of the received slip amongst the writing telegraphists. In practice in this country, for circuits of moderate length it is generally considered preferable to provide direct Morse apparatus worked simplex, duplex or quadruplex as circumstances may dictate.

With overhead lines the limit of speed in automatic working is that imposed by the receiving apparatus, which, owing to its self-induction, obstructs the reception of Morse signals at a higher speed than that named. This difficulty has been overcome by substituting a chemical for an electro-magnet receiver. In this form the current at the received end passes through a long paper ribbon saturated with a solution which is decomposed by a positive current. The Morse signals appear in blue lines on the received slip.

It is said that with this method a maximum speed of 1,000 to 1,200 words is possible under favourable conditions, but the difficulty in working at such high speeds, where characters are received in Morse code and have to be transcribed manually, is the division and distribution of the slips amongst the large number of writers necessary to keep abreast of the work, the precautions needed to avoid loss of messages, the injurious effect of brief contacts caused by workmen which result in the loss of several words, and last but not least, the difficulty and delay in obtaining repetitions where errors, false signals or missing words, render this necessary.

All the foregoing methods increase the carrying capacity of the wires; in other words, they reduce the capital expenditure per message, but none of these increase the output per operator, nor do they diminish the working cost in the instrument-room; in fact, with high-speed automatic transmission this cost may be higher than with other methods described. The messages have to be prepared by the perforation of the punched slip, telegraphists have to control the sending and receiving apparatus, and the Morse slips, as they are reeled off the receiving apparatus, have to be divided and distributed amongst a number of operators for transcription. The initial preparation of the transmitting slip will always, of course, be necessary in all automatic systems, but inventors have turned their attention to increasing the speed and reducing the cost of transcription at the received end, in the case of manual as well as automatic sending, by the substitution of typing apparatus worked mechanically or electrically for the manual transcription. A very considerable number of instruments has been designed to achieve this end, but one of the earliest which has met with permanent success, and by means of which a very large proportion of the work in Europe and nearly the whole of the trans-Continental work is dealt with, is the well-known Hughes's type-printing instrument. Each instrument comprises a type-wheel, which consists of a disc on the periphery of which are embossed the letters of the alphabet, numbers and other signals that have to be transmitted; a piano-like key-board on the keys of which are engraved the letters and signals which appear on the type-wheel; and a horizontal plate with a series of slots arranged in a circle. Enclosed in each of these slots and connected with one of the sending-keys is a movable plunger which is raised when the key is depressed, but which normally lies flush with the surface of the plate. An arm carried on a vertical shaft in the centre of the plate is caused to revolve above it by the motive power which drives the instrument, and when a key is depressed this arm is arrested momentarily by the protruding plunger and a current is sent to the distant station. The printing disc and the revolving-arms at both sending and receiving-stations move in unison, this being effected mainly by the action of the governor seen in the view, any slight want of coincidence being corrected mechanically each time a letter is printed. Below the type-wheels are long paper ribbons, and it will be understood that both instruments starting from zero and running uniformly, then when a key is depressed and the plunger corresponding with the letter to be signalled is raised, the electrical current is sent to line at the moment that the letter to be printed is immediately over the paper, and if the latter is raised momentarily that letter is printed.

The Hughes method of transmission has many advantages. It provides a clearly-typed message for delivery instead of a written one, it removes a possible source of error in transcription, and it increases the speed of working as compared with Morse by about 25%. It can be duplexed and it is used by the Post Office on all its Continental wires. It has, however, the disadvantage that a considerable interval of time elapses between the transmission of two consecutive signals owing to the revolving arm having to traverse all the intervening letters. Baudot has obviated this waste of time by adopting the multiple system of telegraphy. He entirely abandons the Hughes method of transmission, and he forms an arbitrary signal code which, by means of five consecutive currents, some plus some minus, in combination, he represents each letter of the alphabet, figures or other signals. By his method he can provide four or six channels simultaneously on one wire, each being worked manually. In the quadruple system, that most generally in vogue, he uses four separate keyboards, each containing five keys. Either key when in its normal condition is in a position to send a negative current and when depressed a positive current to line. Each of the five keys of one keyboard is connected to five separate and contiguous metallic contacts arranged in a circle. An inner continuous circle is connected to the line wire. A revolving arm, moving at a uniform speed, connects in regular sequence the individual key sections with the continuous line circle, and during each revolution it transmits through the line the groups of signals formed on each keyboard. At the receiving end a corresponding arrangement, the arm moving at the same speed, connects the line in regular sequence with the four receiving instruments, each set being provided with five polarised relays working five electro-magnets.

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During each revolution of the arms at the sending and receiving ends the electro-magnets repeat the positions of the transmitting keys, the armatures of those receiving positive currents being raised and those receiving negative currents depressed, and it remains only to translate these arbitrary code-signals into printed letters. At each receiving instrument two discs, firmly fastened together, have on their peripheries a series of serrations, corresponding with the arbitrary code, which, in certain defined positions, represent the various letters of the alphabet. Riding on the periphery of one of them are five levers termed selectors, each of these levers being so pivoted as to be susceptible of a slight to-and-fro movement on its axles, and also of a transverse movement in the line of the axle. When all the electro-magnets have their armatures raised the selectors rest on the inner disc, but if a certain number of the armatures are depressed then, through the action of intermediate levers, the corresponding selectors are shifted to the second disc. As the two discs revolve together the combined selectors at some point drop simultaneously and for a brief interval into the series of serrations which correspond with the letter code signalled from the far end, and this movement and the rapid jerk out of the serrations as the discs revolve causes the letter to be printed from a type-wheel at which revolves at the same speed as the discs. The uniform revolution of the contact arms, the coded discs and the type-wheels, are maintained by a clever adaptation of governors and brakes partly electrical, partly mechanical, and provision is likewise made for the lag of the current in transmission over the line.

The Baudot system admits of the transmission of a much larger number of messages over each wire than the Hughes. It is also more flexible, inasmuch as the various channels it provides can be divided amongst an equal number of towns; thus Paris can use two channels to Lyons and two to Marseilles over a Paris-Lyons circuit extended from Marseilles, and so on. It is largely used in France and has been introduced into this country.

There are three distinct methods of telegraphic transmission with which we are mainly concerned to-night, although others might be mentioned. In the first an arbitrary code of signals is repeated in similar arbitrary signals by which the alphabet is artificially represented and the message is read by a skilled operator; in the second, what may be termed the dial type of apparatus is used, where two type-wheels, either moved mechanically or electrically, revolve isochronously, and they may either show fleeting letters or print them in permanent characters; and in the third an arbitrary set of electrical signals is devised which actuates specially-designed apparatus which may reproduce the message in legible characters, printed or even written. The third method has been utilised by various inventors and applied to automatic transmission so as to dispense with manual transcription at the receiving station. In all cases a paper ribbon or slip is perforated by punches generally actuated by a specially-designed type-writer keyboard, in which the depression of any key causes a series of perforators representing the arbitrary combination of the corresponding letter to appear on the slip. This is passed through an automatic transmitter, the electrical currents corresponding with the perforators are transmitted over the circuit and the distant apparatus actuated.

Murray has devised a system which has undergone lengthy trials both at home and abroad. His slip has one row of perforations which gears into the moving mechanism of the transmitter, and below this a second series of perforations which represent his artificial signalling code, which is of the Baudot type. The transmitting and receiving apparatus must run isochronously, and this is provided for by an ingenious method shown on the diagram, but which time does not admit of explaining in detail. When the vertical plunger passes through a perforator a positive current is sent over the circuit, and when the plunger is stopped by the paper a negative current circulates. The result at the receiving apparatus is that an exact counterpart of the transmitted slip with its perforations is reproduced, and this perforated slip is passed through and actuates an automatic typewriter which prints the message. The typing machine is fitted with five horizontal plungers which are prolongations of an equal number of slotted combs to which in action a to-and-fro motion is imparted. The perforated slip acts on the principle of the Jacquard loom, and when at a given moment a series of perforations appear the corresponding plungers move forward and the remainder are arrested by the unperforated part of the paper. The slotted combs are at the moment so grouped that the one letter indicated by the code is actuated by the controlling motive power and it is accordingly printed, and the combs restored to their normal position ready for the next letter. The message is typed in page form.

Creed has worked in the same direction, but he uses the ordinary Wheatstone alphabet already described, and of course the Wheatstone transmitter. At the receiving end a perforated Wheatstone slip is reproduced by a punching machine shown on the screen, which, controlled by the reverse currents from the transmitter, and, using compressed air as a motive-power, perforates the received slip at considerable speed. This slip is then passed through an automatic typewriter adapted to work with the Wheatstone alphabet, which types the message on a long slip, to be gummed on the telegraph form. In both these cases the received slip can be inserted in a second automatic transmitter and the message sent on to another town—an advantage in the transmission of news, which frequently has to be re-distributed from large provincial centres to other towns having no direct communication with London. Both these systems are in use in the British Post Office.

Siemens & Halske in Berlin have devised an automatic system in which, by means of suitable apparatus, the message is printed by the receiving apparatus direct by photographic methods. The final typed characters are produced photographically by an electric spark, which momentarily illuminates the required letter. The alphabet is stencilled on a revolving disc, and the arrangements are such that the electric spark passes only when the letter corresponding with the arbitrary signal is in the right position for printing.

The Western Union Telegraph Co. in America, the land of long-distance circuits, has introduced extensively a system known as the Barclay automatic type printing apparatus. At the sending end the code of electrical signals adopted consists of long and short intervals, either marking or spacing, representing the various letters of the alphabet. Every letter is represented by six current alternations, but the receiving apparatus is so designed that although every current acts on an escape wheel that makes a momentary contact with certain selecting relays, only those of long duration effect any movement in the latter. There are 32 printing magnets which act as the keys of a typewriter and cause the message to be printed direct on the receiving instrument.

It may be added that, although any one of the systems described or referred to can be made to do excellent work, the actual selection of the apparatus best calculated to meet the requirements of any country depends entirely on local conditions, length of the lines, character of the work to be dealt with, idiosyncrasies of the staff, etc., and that it would be eminently unwise to dogmatise on the subject. To what extent uniformity of practice is likely to arise in the future is a doubtful question, as each country is likely to progress on the lines which have been firmly established as best adapted to its wants. In this respect telegraphy may be said to occupy a somewhat unique position from the inventor's point of view, there being no tendency, at present, in the direction of adopting one particular type of apparatus as being best adapted for all purposes.

(To be continued.)

"B.T.H." D.C. Motors.

The British Thomson-Houston Co., Ltd., Price List No. 247, illustrates and describes an entirely new design of B.T.H. Continuous Current Motors and Generators, in which are embodied all the latest features in this class of apparatus. These machines can be fitted with various styles of covers, rendering them flame-proof, dust-proof and moisture proof, and they can thus be installed for tool-driving where small chips of metal are liable to drop into the motor, for tool-driving in exposed positions where rain may beat into the motor, for operating paint-mixing machines, pumps, etc., where the motor would be liable to splashes of paint or water: or for driving wood-working machinery, coal hoists, etc., where dust is likely to enter the motor. They can also be supplied fitted with a fan.

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UNITED STATES: Mr. E. Brandon, 27, Thames Street, New York.
CANADA: Messrs. Walsh & Stoer, Stair Building, Toronto.

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Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents and Small Advertisements by 9 a.m. on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements, 24 words 1s. per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

Situations Vacant, 24 words 1s., three insertions 2s. 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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TELEGRAPHY AND TELEPHONY.

Sir John Gavey must be congratulated on having fulfilled a useful piece of work in his James Forrest lecture before the Institution of Civil Engineers, on the recent developments in telegraphy and telephony. The "G.P.O." is so often decried for its many genuine or alleged defects that it is interesting to have from so distinguished an official and scientist not an *apologia*, but a plain statement of fact. Sir John, indeed, in his lecture reported elsewhere, does not deal with the British Post Office *per se*, but the mere historical narration of events in both telegraphy and telephony clearly demonstrates that our great Government Department is, after all, quite alert enough to encourage inventors, to take advantage of, and develop, improvements and new departures. However, like the lecturer, it is not our purpose to defend or praise the Post Office. Telegraphy is practically the father of electrical engineering, for the wonders of modern science have sprung directly from the efforts to transmit messages invisibly by means of electric energy. It is quite a brief history, a period within which much has been achieved, enough to show that the vast problems still before us will sooner or later be solved satisfactorily. But each step forward brings into line a fresh crop of difficulties to be overcome, opening up vistas of still wider fields for conquest. There is room in these two branches, both on the scientific and industrial sides, for any amount of human energy. Though in time short, in progress there is a very long stride between the simple form of Morse circuit transmitting one message at a time over a line and the various multiplex systems in use to-day which enable a large number of messages to be sent backwards and forwards simultaneously over one conductor, and, by means of the Wheatstone system, transmitting 450 words per minute. We may yet do better than this, for, as the lecturer said, with overhead lines the limit of speed in automatic working is that

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imposed by the receiving apparatus. It is in this direction that much work is being done, not without success, as the Hughes method, with its 25% gain in speed over the Morse system, and its delivery of a clearly typed message, proves. Baudot in France has improved on Hughes, and Murray with us is helping largely in forcing the pace, economising time, labour, and capital outlay. We have in Germany Siemens & Halske putting forward a receiver which reproduces the message by direct photographic messages, Barclay in America with his improved automatic type printing machine, and has not London just been startled by different forms of the telewriter? But even greater wonders are in store. Meanwhile we have to improve our conductors. Much has been done to overcome resistance, to reduce leakance. With modern conductors we have an electrostatic capacity of about 0·013 to 0·014 microfarad per mile, which admits of vast increase of speed in overhead telegraphy. In cable work, paper insulation has not only brought about economy, but improved working. In submarine work the Kelvin & Thompson receiving instruments still hold the field; admirable as they are, however, we need not consider them the last word. In telephony, Sir John Gavey pointed out, where a frequency of between 1,800 and 2,000 vibrations per second was necessary the retarding effects of capacity and inductance had to be overcome, otherwise there was a blending and blurring which was fatal to the transmission of speed. This was done by loading, and while the ideal method would be to increase self-induction uniformly throughout the length of the conductor, in practice great success was obtained by lapping a copper conductor with thin iron wire or tape of a high magnetic permeability. Or, again, by distributing magnetic coils at uniform distances of a mile or two apart. This has increased the distance over which speech can be transmitted from 2½ to 3½ miles. Obviously here, again, there is room for improvement, as the recent triumph of the G.P.O. in laying a cable with distributed inductance between England and France, and thereby quadrupling the range of speech as compared with an unloaded cable, testifies. The rapid and enormous development of the telephone service makes progress in mechanical contrivances imperative, which is hopeful for the future of electricians. It is to be noted that in telephony as in telegraphy, the "wireless" methods have in no way displaced the ordinary methods where conductors are necessary. Nor has the advance of telephony told against telegraphy. There is an advance in all directions, and we even see the most interesting alliance, whereby the same conductors are utilised to transmit both telegraphic and telephonic messages. Without traversing the whole ground so ably covered by Sir John Gavey, the general impression left is that in these twin brethren of the great family of electrical industry, we have extremely lively youngsters, showing immense capacity for development in many directions, and calling for the skilled thought and manipulative dexterity of strong battalions of electrical engineers. Good work is being done, and more remains to be accomplished.

CATALOGUES AND PRICE LISTS.

Messrs. J. H. Holmes & Co., makers of the "Castle" type of D.C. motors and dynamos, have brought out an elaborate catalogue, giving illustrations and useful details about their machines.

Messrs. F. Wilkins & Bros., Ltd., are issuing a leaflet illustrating their new patent "Rainproof" globe lamps for outdoor use.

A folder issued by Messrs. C. E. Lugard & Co. illustrates their "Pillow" flexible coupling, both insulated and uninsulated.

A valuable little booklet on "Centrifugal Pumps," containing diagrams, curves and data is published by Messrs. Holden & Brooke, Ltd., of Manchester.

Messrs. H. T. Boothroyd's price list "N.E." 1910 deals with D.C. motors and dynamos.

Messrs. Donovan & Co.'s new illustrated price list is devoted to a great variety of electric bells, switches and telephones, and Leclanche's dry cells.

Booklet No. 2 from Messrs. Cecil E. Lugard & Co., of Chester, deals with the "S.M." magnetic drive for application to planing machines.

Two recent additions to Messrs. Crompton & Co.'s list of publications include "Moving Iron Electrical Instruments for Continuous and Alternating Circuits," and "Electrical Instruments in 4 in. diameter cases for small switchboards, starter panels, X-ray, galvanic and dental appliances." Both are illustrated.

Messrs. Jens Orten-Boving & Co. have brought out an elaborate pamphlet on the "Jahns" governor. Sections are given, the working parts being shown in tints to facilitate an understanding of the system.

Messrs. H. Tinsley & Co.'s sheet No. 21 gives an illustrated description of Dr. C. N. Drysdale's A.C. Potentismeter.

The Traction Supplies Co., Ltd., have issued Sheet 1, illustrating White's patent controller fingers, with reversible and renewable contact.

A leaflet illustrates and describes the "Hof" combined ironclad switch and fuse, manufactured by Messrs. H. O. Farrell, & Co., of Manchester.

An excellent four-paged circular on "Street Lighting," showing "E.H.C.P." and "Globeless" lanterns and special fittings for side streets, has been issued by Mr. Haydn Harrison.

The Chloryde Electrical Storage Co., Ltd., in their No. 80 booklet, have brought together a great deal of interesting matter. Their various specialities are also described and illustrated.

List No. 37 of the India Rubber, Gutta Percha & Telegraph Works, Ltd., describes and illustrates the "Silvertown" multipolar F.E. and F.E.P. dynamos and motors.

Messrs. D. H. Bonnella & Son, Ltd., send out an illustrated leaflet describing their special "Ampere" cell.

The latest publications of the Edison & Swan United Electric Light Co., Ltd., are devoted respectively to "Ediswan" bells, batteries and pushes, and to "Ediswan" telephones and accessories.

Ragosine & Co., Ltd., have issued a price list of varnishes and paints.

A booklet worthy of note is that just sent out by the A.E.G. Electric Co., Ltd., dealing with "Electricity in Textile Factories." It describes and illustrates very fully some late and special continental developments.

Mr. E. E. Coy issues an illustrated leaflet of his "Coy" small power motors, dynamos and combined electric sets for accumulator charges, etc.

FINANCIAL NOTES.

ELECTRIC AND GENERAL INVESTMENT.—The directors recommend a dividend of 1s. 2 2-5d. per share, or 6% on the Ordinary shares for the past year. The trustees for the Ordinary shares reserve fund and the Founders' shares reserve fund declare dividends of 6d. per share and £7 per share respectively out of the dividends received.

CHADBURN'S (SHIP) TELEGRAPHS.—The directors have declared a dividend on the Ordinary shares at the rate of 10% per annum, less income-tax, for the half-year ending March 31 last, making, with the interim dividend of 6% per annum already paid, a dividend of 8% for the year.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

BRIDLINGTON GRAMMAR SCHOOL.

TENDERS are invited by the Governors of the above School for an ELECTRICAL INSTALLATION on the O.S. System, receiving its supply from the Corporation mains.

Copies of Specification can be had from Mr. Arthur J. Beckett, Electricity Works, Bridlington, on application, with £1 1s. enclosed, returnable on receipt of a *bona-fide* Tender. Plans of the work can be seen at the office of the Engineer or on the site by application to the Headmaster, A. Thornton, Esq. Tenders to be received by A. Thornton, Esq., The Grammar School, not later than July 11, 1910, and endorsed, "B.G.S. Electric Light."

BELFAST UNION.

TO ELECTRICAL ENGINEERS.

The BOARD OF GUARDIANS INVITE PROPOSALS for CARRYING OUT an ELECTRICAL INSTALLATION at the ABBEY AUXILIARY WORKHOUSE, WHITEABBEY, in accordance with the Plans and Specifications submitted by Messrs. Young & Mackenzie, Engineers, etc., which can be seen at this office.

A copy of the Block and Engine Room Plan, with Specification and Schedule, can be obtained from the undersigned on payment of One Guinea (not returnable).

Tenders made out on the Forms, and endorsed "Electric Lighting," to be lodged in the Tender Box, Board Room, Union Workhouse, before 12 o'clock noon on TUESDAY, JULY 5.

The Tenders should set forth the names of two sureties who are willing to enter into a joint and several Bond for the due performance of the Contract.

The Guardians do not bind themselves to accept the lowest or any Tender.

(By order) JOSEPH W. ROBB,
Clerk of the Union.

Clerk's Office, Union Workhouse.

CITY OF LEEDS.

The STREET LIGHTING COMMITTEE invite Tenders for Supply of COPPER LAMPS, LAMP PILLARS, LAMP FURNITURE, PILLAR LAMP IRONS and CARRIAGES, WALL BRACKET IRONS, SHEET COPPER and COPPER TOPS, and GLASS.

Further particulars and Forms of Tender may be obtained on application to the Superintendent of Street Lighting, Springwell-street Depot. Tenders, properly endorsed, to be delivered at my Office not later than WEDNESDAY, JULY 20.

ROBERT E. FOX, Town Clerk.

Town Hall, Leeds.

ST. PANCRAS BOROUGH COUNCIL.

St. Pancras Borough Council invites Tenders for supplying a MARINE TYPE WATER TUBE BOILER, fitted with Induced Draught.

Copies of Specification, Conditions of Contract and Forms of Tender can be obtained upon application to the Electricity Department Offices, 57, Pratt Street, Camden Town, N.W., on payment of a deposit of £2 (which will be refunded only on the Specification being returned accompanied by a *bona-fide* Tender).

Tenders to be sent to the undersigned, endorsed TENDER FOR "MARINE TYPE WATER TUBE BOILER," etc., by 10 o'clock on Monday, July 11th, 1910.

The Council do not bind themselves to accept the lowest or any tender.

C. H. F. BARRETT,
Town Clerk.

Town Hall,
St. Pancras Road, London, N.W.
July 1st., 1910.

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Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

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HOME.

BELFAST.—Board of Guardians invite tenders for electrical installation at the Abbey Auxiliary Workhouse, Whiteabbey. Particulars and plans (one guinea, not returnable) from Clerk to Guardians, Union Workhouse, Belfast. July 5.

BRIDLINGTON.—Governors of the Grammar School invite tenders for electrical installation on the O.S. system. Supply from Corporation mains. Specifications (21s.) from Mr. A. J. Beckett, Electricity Works, Bridlington. July 11.

CANTERBURY.—City invite tenders for supply of coal at the Electricity Works for one year, about 1,250 tons, from August 2, 1910. Fine coal and Welsh Steam Navigation about 200 tons. Particulars from Town Clerk. July 6.

DEWSBURY.—Education Department, Dewsbury, invite tenders for electrical and hot-water installation at the Batley Carr Schools. Particulars from Holtom & Fox, Corporation-street, architects. July 14.

EALING.—Borough Council invite tenders for surface condensing plant. Specification (£2) from Borough Electrical Engineer. July 4.

EDINBURGH.—School Board invite tenders for electric light installation. (Particulars from G. Thomson, 11, Randolph-place). July 1.

HORNSEY.—Borough Council invite tenders for wiring, &c. school. (Specification, 10s. 6d., Borough Electrical Engineer, Tottenham-lane, N.). July 9.

LLANDAFF AND DINAS POWIS.—Rural District Council invite tenders for Whitchurch electric lighting, switch gear, transformers, switchboard, and fittings, &c. (Specification, Lewis & Fletcher, Prudential-buildings, St. Mary-street, Cardiff). July 4.

LEEDS.—Corporation invite tenders for supply of copper lamps, lamp pillars, lamp furniture, pillar lamp irons and carriages, wall bracket irons, sheet copper and copper tops, and glass. Particulars from Superintendent of Street Lighting, Springwell-street Depôt. July 20.

LONDON.—London County Council invite tenders for underground conduit line Battersea Bridge to King's-road, Chelsea (Estimated cost, £35,000.)

LONDON.—County Council invite tenders for the manufacture and supply of (*a*) 250 electric tramcar bodies, (*b*) 250 sets of centre-bearing swing bolster car-trucks, (*c*) 250 complete electrical equipments for operation upon both conduit and overhead trolley systems of traction. Specifications (40s. for each section) from Cashier, County Hall, Spring-gardens, S.W. July 5.

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There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

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City and Guilds of London Institute,
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S. SOKAL, Chartered Patent Agent,

AND

Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.

55, CHANCERY LANE, LONDON, W.C.

OLDHAM.—Corporation Tramways.—Moorside to Grains Bar extension. (Estimated cost, £11,000).

RAWTENSTALL.—Corporation invite tenders for labour and materials of an electric tramway: Contract No. 5, permanent way construction; No. 6, steel poles, overhead line equipment and accessories; No. 7, cables, conduits, trenching, section boxes and accessories. Particulars (£5) from Mr. C. L. E. Stewart, Borough Electrical Engineer. July 1.

ROTHERHAM.—Borough Council.—Annual stores for tramways. (Particulars from Manager, Depôt). July 9.

ROTHERHAM.—Borough Council invite tenders for: No. 1, annual supply of single vulcanized bitumen covered cable and of ampere hour meters (2, 5, 10, 25, 50 amperes, 230-460 v.). (Particulars from Borough Electrical Engineer). July 9.

TONBRIDGE.—Urban District Council invite tenders for Lancashire boiler, economiser, and pipework. (Particulars from Borough Engineer). July 1.

TUNBRIDGE WELLS.—Borough Council invite tenders for high and low tension paper-insulated cables. (Particulars from Borough Electrical Engineer, Stanley-road). July 9.

OVERSEAS.

ADELAIDE, S.A.—Postmaster-General.—Cordless switchboards. (Specification No. 3,381). July 6.

CONSTANTINOPLE.—Admiralty invite tenders for electrical appliances, and cable as follows:—400 metres 120 amperes 60, 58 sq. mm.; 100 m. 30 a., 21·93 sq. mm.; 2,000 m. 5 a., 3·59 sq. mm.; 2,500 m. 1·8 a., 1,168 sq. mm.; 180 m. 10 a., 5·16 sq. mm.; 100 m. 1,168 sq. mm. July 8.

MELBOURNE.—Postmaster-General.—400 telephones, wall sets, magneto, complete (specification No. 220 and pattern C. No. 11); and 200 telephones, bridging table (specification No. 221, and pattern N.S.W. 339, schedule 321). July 9.

TENDERS ACCEPTED—Home.

LONDON, ST. PANCRAS.—The Borough Council's Electricity Committee have accepted the following tenders sent in by Messrs. J. H. Beattie & Co., supply from 14,000 to 16,000 tons of Mansfield Nutty Slack to the King's-road station, at 12s. 1d. per ton; of 2,000 tons of Hucknall Small Nuts coal, at 13s. 11d. per ton; of from 6,000 to 7,000 tons of Shirebrook Best Small Nuts Coal, to be delivered to Regent's-park station at 13s. 11d. per ton, or to King's-road station at 13s. 7d. per ton, as directed; also the offer of Messrs. Bradbury, Son & Co., to supply 500 tons of Bwllfa Welsh Coal in bulk to the Regent's-park station, at 22s. 4d. per ton.

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There is an Adams "Igranic" Controller working in London which has made nearly 100,000 trips in three years without an involuntary stop, and only costing a few shillings in renewing carbon circuit-breaking tips.

IGRANIC

Lift Controller.

That is good work, and you can understand why one lift manufacturer who uses Adams "Igranic" Lift Controllers exclusively, has booked orders to keep his shops occupied for the next six months.

106, New Bond Street, LONDON, W. Works—BEDFORD.

LONDON, HAMPSTEAD.—The Borough Council have accepted the tender of Messrs. Willans & Robinson, Ltd., for one of their turbines combined with an Oerlikon alternator, the amount thereof being £1,825.

The London and North Western Railway have accepted the tender of William Geipel & Co., Vulcan Works, St. Thomas-street, London, S.E., for the supply of Henrion arc lamp carbons during the year ending June 30, 1911, for the whole of the Company's requirements, the total annual consumption amounting to 1,373,000 carbons. The above is a renewal of last year's contract.

NOTES.

Storage Batteries.

An excellent example of the use to which storage batteries may be put is set forth in the latest publication issued by the D. P. Battery Co., Ltd. This little album describes an interesting installation of battery and automatic reversible booster carried out at Messrs. Rowntree's Cocoa Works at York. These works contain two generating stations, with a total capacity of 7,050 amps. In order to keep up a steady voltage and to guard against any possible breakdown, and to provide steady, economical running, it was decided to go in for a storage equipment. The battery consists of 112 D.P. cells, capable of discharging 800 amperes for one hour, with a final pressure of 193 volts. The positive plates are of the Planté type, and the negative of the "Sponge" type, corroding with remarkable equality. The booster and switchgear were made by Messrs. Crompton & Co., Ltd., and the plant laid down to the specifications and under the supervision of Messrs. Shepherd & Watney, consulting engineers, Greek-street Chambers, Leeds.

Disc and Drum Turbines.

The Chief Commissioner of the New South Wales Government Railways, since his arrival in this country a few weeks ago, has confirmed the provisional order which had previously been given to Messrs. Willans & Robinson, Ltd., of Rugby, for a turbo-alternator and surface condenser of 6,000 kw. normal capacity. Besides this, a turbine of the Willans "Impulse-Disc and Drum" type is being supplied for meeting the requirements of the Sydney authorities, as a supplement to two turbo-alternators of the above capacity already installed in the Sydney power house. The same firm have also recently received from the Corporation of Londonderry an order for a 400 kw. "Disc and Drum" turbine of the mixed pressure type with Messrs. Willans & Robinson, Ltd., of Rugby. The turbine is intended primarily for working with exhaust steam, but can also be used with high pressure steam when required.

Turbine Pumps for Motor Fire Engines.

In a well got-up pamphlet, Messrs. Mather & Platt, Ltd., give particulars of a departure which they have recently carried out in conjunction with the makers of motor fire engines for the supply of a special turbine pump for use in connection with fire engines. These pumps have proved a great success, and have been adopted by many corporations on account of the improved efficiency to be obtained over the old type of plunger pump.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is to be presumed, from the nature of the cases, that this will be so.

Ashington: Osborne Blythe, architect, Ashington. Council chamber, offices and caretaker's house.

Audenshaw: J. T. Dewhurst, sanitary inspector, Council Offices, Audenshaw, Lancs. Equipment of sanitary offices.

Barkingside: Hospital, Dr. Barnardo's Girls' Village, Barkingside, Essex.

Barry: G. A. Birkenhead, architect, St. Mary-street, Cardiff. Conversion of Barry Island Manual Instruction Room into a Domestic Centre, and new Manual Instruction Room and caretaker's house.

Cardiff: W. Ware and Williams, 6, Pembroke-terrace, Cardiff. Parish hall and classrooms in Wyeverne-road.

Clatterbridge: J. H. Davies & Sons, architects, 14, Newgate-street, Chester. Observation pavilion, and alterations and additions to administrative block at Sanatorium.

Colchester: County Asylum.

Darenth: Metropolitan Asylums Board. Work rooms at Darenth Asylum.

Edinburgh: City architect. Alterations at Fever Hospital, Portobello.

Eltham: Moscrop-Young & Glanfield, architects. Parish hall.

Exeter: J. Jerram, architect, Bedford Circus, Exeter. New offices and play-sheds at the Episcopal Schools, Mount Dinham.

London, Poplar: J. & W. Clarkson, architects, 136, High-street, Poplar. Nurses' classrooms at Poplar and Stepney Sick Asylum.

Nottingham: W. E. Bickers, architect, 1, Bank-street, Bradford. Picture Palace.

Nuneaton: F. C. Cook, Borough Surveyor. Additions to Free Library.

Romford: E. J. Little, architect, Hornchurch-road, Romford. Business premises and dwelling houses.

Romford: A. S. R. Ley, architect, 54, Bishopsgate-street Without, London, E.C. Council school.

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INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Conversazione.

The annual conversazione of the Institution of Electrical Engineers took place at the Natural History Museum, South Kensington, on Tuesday evening, and brought together a large and distinguished company. The guests, numbering more than a thousand, were received by the esteemed President, Dr. Gisbert Kapp and Mrs. Kapp, and the Council of the Institution. Among others present were noticed: Lord and Lady Strathcona, Sir William Crookes, Sir William H. Bailey, Sir Edward Clarke, Sir John and Miss Gavey, Sir William and Lady Wilkin, Sir Somerset R. French, Sir A. Keogh, Sir Aston and Lady Webb, Sir Robert Hunter, Sir Walter and Miss Ruth Howell, the Hon. A. A. Kirkpatrick, Major General Ferrier, Major W. A. J. O'Meara, Dr. Silvanus P. Thompson, Professor Adrian Brown, Professor T. Mather, Professor J. Perry, Mr. S. Z. de Ferranti (President elect), Mr. W. M. Mordey (Past President), Mr. A. Siemens, Mr. A. Taylor (President, Institution of Mining and Metallurgy), Mr. W. H. Patchell, Mr. J. H. Rider, Mr. W. Duddell, Mr. G. Stoney, Mr. P. V. McMahon, Mr. P. F. Rowell (Secretary), etc. The String Band of the Royal Engineers performed in the central hall, and the Alexandra Ladies' Quartette in the Shell Gallery. The function proved an unqualified success.

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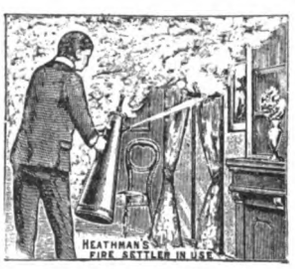

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LONDON COUNTY COUNCIL TRAMWAYS.

The accounts of income and expenditure for the year ended March 31, 1910, in connection with the Council's tramways undertaking, just issued, shows that the tramways system extended over a total length of 135½ street miles, being 115½ miles of electric lines and 20 miles of horse lines. The whole of the system is worked by the Council with the exception of 1⅝ miles (partly double and partly single line) of track in Harrow-road. and a length of ⅜ mile (double line) in Archway-road, Highgate, which are worked by the Metropolitan Electric Tramways, Ltd., and a length of about ⅜ mile (double and single lines) in Lea-bridge-road, which at the date named was worked by the Leyton Urban District Council under agreement with the Council. The undertaking comprises the lines transferred to the Council from various tramway companies, together with new lines constructed by the Council itself.

The capital expenditure on the undertaking up to March 31, 1910, amounted to £10,709,503 15s. 10d., of which £1,225,941 17s. 9d. represents expenditure during the year 1909–10.

The total sum provided for redemption of debt up to the same date amounted to £1,372,337 10s. 10d. out of revenue, and £319,659 12s. 4d. from the proceeds of sales of horses, old materials, etc. The net debt outstanding on March 31, 1910, after deducting £118,408 for the value of surplus land, was, therefore, £8,899,098 12s. 8d.

The Council decided on June 23, 1908, subject to the approval of His Majesty's Treasury, to repay the outstanding debt (estimated at £960,000) on the capital which will be obsolete at March 31, 1914, owing to the electrification of horse tramways, within 15 years from that date. The present position with regard to this obsolete capital expenditure has been shown in the accounts for 1909–10. It will be seen that the amount of obsolete capital, less proceeds on sales, on March 31, 1910, was £1,415,628 9s. 11d. Deducting the amount provided out of revenue for the redemption of the debt in respect of such capital, viz., £383,182 14s. 8d., the amount still to be provided for in respect of capital already obsolete is £1,032,445 15s. 3d.

The total receipts from the undertaking during the year and the working expenses were as follows :—

	Electric traction. £ s. d.	Horse traction. £ s. d.	Total. £ s. d.
Total receipts ..	1,891,034 12 5	131,968 18 7	2,023,003 11 0
Working expenses	1,056,826 3 2	177,140 17 3	1,233,967 0 5
Surplus on working	834,208 9 3	45,171 18 8 (deficiency).	789,036 10 7

Against this surplus on working may be set the following : Debt charges—interest (gross) £300,017 13s. 10d. and repayment £297,992 5s. 11d., together, £598,009 19s. 9d. ; income tax (Schedule D, in addition to property tax included in working expenses) £13,000. Less—amount provided in previous years in excess of liability as now determined £7,272 17s. 10d. : £5,727 2s. 2d. ; annual payment to London Street Tramways Co. (ceases this year), £7,016 15s. 8d. ; parliamentary expenses, £4,970 19s. 3d. ; deficiency on Drake-buildings (re-housing obligation), £176 3s. 2d., making £615,901. Less—tax deducted and retained from interest on debt, £17,501 0s. 8d., and net interest on cash balances, etc., £1,472 8s. 2d. : £18,973 8s. 10d., making £596,927 11s. 2d. Thus leaving a surplus carried to appropriation account of £192,108 19s. 5d.

The Council decided on June 23, 1908, that provision should be made for renewals at the rate of two-thirds of a penny for each car mile on the total car mileage run on the electric tramways each year ; and that the question of the adequacy or otherwise of this provision should be again considered at the expiration of five years. Provision for the year 1909–10 at this rate, amounting to £110,059 12s. 6d., has been made, and a further sum of £21,571 has also been transferred to the renewals fund to meet the balance of the shortage of past years. A sum of £599 18s. 11d. has also been provided in respect of the lines in Harrow-road leased to the Metropolitan Electric Tramways, Ltd.

The Council also decided, on the same date, that a "General Reserve Fund" to provide for general contingencies, should be established. After deducting from the net surplus on working the sum of £132,230 11s. 5d. transferred to the renewals fund, there remains a sum of £59,878 8s., which has been transferred to the general reserve fund. The Council, on December 21, 1909, decided to charge to the general reserve fund a sum of £25,265, which represented the expenditure incurred in connection with the adaptation of the Aldgate to Bow tramways, for the underground conduit and overhead trolley systems of electric traction which would not have had to be incurred had this route been reconstructed in this manner originally, instead of on the "G.B." surface contact system of traction. The fund on March 31, 1910, after deducting the above-mentioned sum of £25,265, amounted to £70,752 4s. 10d.

The total operating expenses for electric traction were £1,056,826 3s. 2d., including £11,632 1s. 11d. for special charges, or 6·42d. a car-mile run, as compared with 6·74d. a car-mile in 1908–9. The total working expenses in connection with horse traction amounted to £177,140 17s. 3d., or 11·76d. a car-mile run. Considerable loss was sustained during the reconstruction of horse lines for electric traction, as sections of some of the routes had to be closed, and this disorganised the traffic on several important routes.

The following facts should be of general interest. The system in operation on April 1, 1909, included about 85 miles of electric tramways, and during the year a further length of about 30 miles was opened, making a total of about 115 miles. The lines opened during the year include the new tramways from Streatham to Norbury ; along Amhurst-road and Dalston-lane ; from the *Plough*, Clapham-common, to Lavender-hill ; along Crowndale-road ; from John Carpenter-street, Victoria-embankment, to the tramways in Blackfriars-road, including the lines over Blackfriars-bridge, which are owned by the City Corporation and worked by the Council ; along Southwark-street ; along Shardeloes-road and Malpas-road ; junction lines from Great Eastern-street to High-street, Shoreditch, and from Borough High-street to Marshalsea-road ; and the reconstructed tramways from Euston-road (Tottenham-court-road) to Holloway-road ; from Loughborough-junction to Norwood ; from Beresford-square to Nile-street ; from Tunnel-avenue to Rainton-road ; along Farringdon-road and King's-cross-road ; from King's-cross to Hampstead-heath ; from the *Britannia* to Malden-road ; from Prince of Wales'-road to Archway-tavern ; along Highgate-hill ; from Aldgate to Bow ; from Whitechapel to Stamford-hill ; from Nine-elms-lane to East-hill ; along Essex-road ; and from Liverpool-street (King's-cross) to Caledonian-road.

The total number of passengers carried and the car mile run during the year were as follows :—

	Electric traction.	Horse traction.	Total.
Number of passengers ..	418,317,377	33,121,839	451,439,216
Number of car miles run ..	39,545,512	3,614,674	43,160,186

The tramways stud on March 31, 1910, numbered 1,416 horses. The average weekly cost for provender and litter during the year was 9s. 8·74d. a horse, as compared with 9s. 0·61d. in 1908–9.

SIEMENS' LAMP WORKS ANNUAL OUTING.

On Saturday last Messrs. Siemens Bros., Dalston Works, employees visited Brighton on the occasion of their second annual outing. The weather proved showery in the morning, but cleared up about 11 o'clock and turned out splendidly fine. A company of over 500 enjoyed a good journey by a special train which left London Bridge at 7 o'clock, and arrived at Brighton at 8.30, and at once set out in quest of enjoyment. Luncheon was provided by the company, and an excellent menu was served in the spacious hall of the Aquarium at 12.30, everybody doing good justice to the excellent fare which was provided. A vote of thanks to the committee and Mr. Hicks, the secretary, for the general success of the outing was proposed by Mr. Holmes and carried with acclamation. A musical programme was arranged at the Aquarium, and Mr. Wilson, the organist, contributed to this by playing many popular and classical items. The party then dispersed, and went once again in divers ways pleasure-hunting, and many of the surrounding places of interest were visited. Altogether, the outing was thoroughly enjoyable and successful.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

During the past week Tyneside men have emulated the lilies of the field. During the Newcastle "Race Week" work is thrown aside. Offices are closed for the major part of the time, while many works are shut down. This may, possibly, explain to business men in other parts of the country why their Newcastle correspondence seems slack. It is also practically impossible to report upon new developments in this column.

Sir Christopher Furness.

The elevation of Sir Christopher Furness to the peerage has been received with much satisfaction in this area. In his connection with many of the large engineering and kindred industries, such as the Weardale Steel and Coal Co., Ltd., the Broomhill Collieries, Ltd., etc., he is a large consumer of electric power, and it is by no means a poor argument for electric power in factories and workshops to say that Sir Christopher Furness, ironmaster, coal owner and engineering works proprietor, who has risen by the sheer force of his own individuality, is such a firm believer in the use of electricity.

The Tyne Tube.

It has been announced as the result of an intimation received by the Town Clerk of South Shields, that the promoters of the North and South Shields Electric Railway (Tube) Bill have withdrawn the measure. Up to the present the reasons for this abandonment have not been made public, but without any inner knowledge of such reasons, it appears to be unfortunate that such a promising scheme for linking the north and south banks of the Tyne, with their large populations, should have fallen through.

Shipbuilding Work on the Tyne.

Shipbuilding activity on the Tyne is showing satisfactory increase. Messrs. Armstrong, Whitworth & Co., Ltd., have received orders from Turkey and China for ships of war, in addition to the work for our own Government which they have in hand. Messrs. Hawthorn, Leslie & Co., Ltd., have orders for torpedo boat destroyers for the British Admiralty, Messrs. Swan, Hunter and Wigham Richardson, Ltd., have orders from the Cunard Co., and other work, while Messrs. Palmers' Shipbuilding and Iron Co., Ltd., of Jarrow, are very full of work, two recent orders being a liner for the British India Steam Navigation Co., and a freight boat of large tonnage for a Budapesth firm. It is reported that Jarrow is now assured of a state of prosperity such as it has not experienced for over three years. All this argues well for electrical orders in the near future.

An Australian Order.

An order of rather more than usual interest is now nearing completion by Messrs. Ernest Scott & Mountain, Ltd., of Gateshead. This is in connection with the extensive mining operations of the Caledonian Coal Co., of Australia. This firm operates several pits, and has adopted direct current power for a considerable number of years, each pit being operated separately by a plant at the pit mouth. Recently, however, it was determined to centralise the power generating plant, a three-phase 3,000-volt 50-frequency system being adopted, motor-generators being installed at the old power-houses converting to 500 volts direct current. Several 250 kw. generators are being built, some to be driven by existing steam plants, while in another case Messrs. Scott & Mountain are building one of their compound vertical high-speed sets. It is sometimes overlooked that this firm builds a very good engine of this type. In addition, several motor-generator sets are being built, of 200, or 250 kw. capacity.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The decision given last week in the Leicester case restraining the Corporation from undertaking wiring and fitting on consumers' premises does not affect the Birmingham Electric Supply Department. The undertaking was owned for some years by a private company which did carry out such work as wiring and fitting, though the accounts were kept separately. When, in 1900, the Electric Supply was taken over by the Corporation, this branch of the business was acquired, but the Corporation has all along left the wiring and fitting to contractors in the city. All that the Corporation is responsible for is the supply of light and power and the fittings up to the terminals. Other local authorities in the district are variously affected by the decision. Several of them have clauses in their Provisional Orders empowering them to carry out the work which was objected to in the Leicester case, but there are a large number without any provision of this sort. The Handsworth Supply is one of those which possesses the desired powers, but has exercised it with considerable discretion. West Bromwich Corporation also has full powers; so has that of Wolverhampton. At West Bromwich practically the whole of the wiring has been done by the department, and no complaint has been received. At Redditch, some two years ago, the local authorities, in deference to the representations of private contractors, ceased to do any work for consumers. The Dudley and Walsall Corporations are in a similar position to Leicester in regard to such work. Generally speaking, the authorities which have powers for doing work on private premises have, while claiming the right to tender for any such work, been very careful to avoid anything which might have the appearance of undercutting private firms.

Bulk Supply Contract.

The Electric Light Committee of the Rugby Urban District Council has entered into a new arrangement with the British Thomson-Houston Co., which has hitherto supplied the Council with electrical energy. Under the new agreement, the company will continue the supply until October 28, 1918. The price to be charged for energy supplied for lighting purposes is to be reduced immediately to 2d. per unit up to 200,000 units per annum; to 1¾d. per unit for quantities between 200,000 and 250,000 units; and 1½d. per unit for all larger quantities. The British Thomson-Houston Co. undertake to maintain a supply of energy up to a maximum of 410 kw., which, combined with the output from the Council's own machine, places at the disposal of the Council an aggregate of 610 kw. The alteration in the terms will result in a saving of over £300 a year to the Council, and it is the intention of the Electric Light Committee to give the consumers the full benefit of the saving.

Gas v. Electricity.

The Gas Department of the Birmingham Corporation is entering to some extent into a new kind of rivalry with the Electric Supply in regard to industrial and lighting requirements. Mains are being laid in some of the streets for the purpose of supplying gas at high pressure for furnace heating and other industrial purposes. It is expected that this will be found useful in some of the special trades of the city, such as the jewellery and metal trades, for annealing, melting, case-hardening, brazing and the like, and the department looks to a development in this direction as a means of creating a new and increased industrial demand for gas, which will be to some extent set off against the supplanting of gas engines by electrical power. The Corporation has not as yet adopted electricity for street lighting, and the introduction of the high-pressure gas will

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probably defer electric lighting in the streets for a further considerable period. Some experiments have already been made in Victoria-square with gas raised to 30-inch water pressure by means of a small compressor situated in the basement of the Council House. In one respect the Gas Department is taking a leaf out of the electrician's book, as the high-pressure mains now being laid will be utilised for the conveyance of gas at a high pressure to be afterwards reduced for consumption at ordinary pressures, and thus a great economy in conveyance and storage is hoped to be effected.

Electrical Appliances for Mines.

A visit was paid by the members of the Warwickshire and South Staffordshire Branch of the Association of Mining Electrical Engineers last week to the works of the Electric Construction Co., Wolverhampton. The party, which was a large one, was received by Mr. W. Bulloch, general manager, and Mr. W. M. Furniss, chief engineer, and was conducted by the latter round the works, visiting the power house, the test bed, the erecting and turning shops, the armature shops, the switch department, the new machine shops, the foundry, the pattern and carpenter shops, the laboratories, and the technical offices. Two of the "Simplex" electric bar coal-cutting machines (of which this firm are the sole makers) had just been completed for customers, and one was seen running. Several of the electric colliery haulage gears were also inspected with interest, and the chief points in both these mining branches of electric plant were fully explained by Mr. Furniss. At the conclusion of the inspection, the visitors were entertained to tea by the company, and Mr. Gidwell returned thanks on their behalf to Mr. Bulloch, Mr. Furniss, and the company. Mr. Bulloch, in reply, expressed his interest in the objects of the new association, and said that the company manufactured a great deal of electric mining plant to which it paid special attention. Mr. A. Hall, President of the Branch, referred to some remarks of Mr. Bulloch's as to the unsuitability of a great deal of the electric work put down for mining purposes, and said that recent statistics carefully compiled in the Northumberland and Durham district, showed that no less than 40% of the total electrical accidents in the mines of that district was due to that cause alone.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

Glasgow Corporation have now decided to subsidise the city rates by a contribution from the Common Good Fund, and in as much as the tramway surplus is the principal feeder of that Fund, this decision means the application of the tramway surplus to the reduction of rates. For some reason which is not explained the opposition to this dangerous innovation in connection with municipal finance in Glasgow was not nearly so strong as one would naturally have expected. On the face of it, it is a subversion of a fundamental principle in municipal control; it tends to divert the centre of attention in a public monopoly from the point of view of giving the cheapest possible supply to the citizens to an attempt to have an ever-increasing surplus for the relief of raising rates. In other words, it converts a municipal undertaking into a profit-making concern. Moreover, it would seem that it will have the indirect effect of lessening care in general expenditure as this surplus will always be in view when fresh ventures are proposed. The fact that it gives a disproportionate amount of relief to the wealthier section of the community from funds to which they have contributed little or nothing does not concern those interested in the application of electricity to public service, but the ultimate effect that it may have on electric traction here and elsewhere will be anything but beneficial.

Glasgow Exhibition of 1911.

The arrangements for the forthcoming exhibition in Glasgow next year are now well under way. With regard to the electrical installation, it is expected that there will be a total demand of some 1,500 kw. The current will be taken from the Corporation mains at 6,500 volts high tension and transformed down to low pressure continuous current by motor transformers placed within the exhibition buildings. The prices to be charged by the Corporation for current will be a flat rate of 2d. for lighting and 1d. for power units.

I.M.E.A. Convention and the Contractor.

The Glasgow Convention of the Municipal Electrical Association was alike as regards numbers and general enthusiasm the best Convention the Association has yet held. Excellent weather together with well-organised and overflowing hospitality on the part of the local Corporations no doubt largely contributed to the success of the meetings, but one was struck with the increasing zest of the municipal engineers when discussing the business side of their work. The two most lively discussions were the first and last, and on both occasions the contractor came in for rather rough handling. If one might offer a suggestion, it would be that the contractors should be more largely represented at these gatherings, as visitors. A considerable delegation could easily be sent from the contractors' Association, and nothing but good would accrue to all parties from a tolerant discussion of their differences.

Smoke Abatement Exhibition.

The practice south of the Border seems to be towards the inclusion of the supply and sale of apparatus and appliances among the powers possessed by the municipal undertaking. At the I.M.E.A. discussion on a resolution that these powers be extended to all municipalities who do not now have them, there was not a dissentient voice in favour of the poor contractor. In Glasgow, up to this time, the contractors and the Corporation officials have worked together in harmony, but speaking from the contractors' point of view, it is time to urge these much-maligned gentlemen to wake up, lest the spirit which is rampant in the South should spread its influence up North. The electrical industry is faced with powerful and thoroughly organised opposition, and it behoves the various branches of the profession to stand shoulder to shoulder. There is a Smoke Abatement Exhibition looming ahead in Glasgow, and so far the local contractors have seemed rather slack in availing themselves of this opportunity to push their wares, but it is rumoured that the local branch of the Contractors' Association have met and appointed a Committee to go further into the matter. One would like to express the hope that these gentlemen will, in their wisdom, advise their brethren to make as large and prominent a show as possible, because on their efficiency *as retailers of electrical apparatus* does their future immunity from invasion by the Corporation depend.

State of Trade.

Local firms doing ship work continue to be fairly busy, but the great majority of the local contractors still find house-wiring jobs few and hard to find. The new Mitchell Library in Glasgow is nearing completion, and the next big wiring job will probably be the 1911 Exhibition, but the building trade generally is at a standstill, and not much fresh business may be looked for now till about the middle of September.

The General Electric Co., Ltd., in Glasgow.

The growth of the General Electric Co.'s business in Scotland is a case in point which goes to show the rapid development of the electrical industry. Some 19 years ago, Mr. H. W. Warde opened a branch in Glasgow for the General Electric Co. for the supply of fittings and apparatus in small premises in West Regent-street. The business has steadily grown till three flats and a basement are barely sufficient to hold the stock which is now handled by an increased staff. Mr. Warde's merits have now been recognised by his company, who have appointed him to look after their business in Australia. Last week Mr. Warde's staff met him at the premises, 71, Waterloo-street,

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Glasgow, and made him the recipient of a token of their esteem in the form of a gold watch, suitably inscribed. The presentation was made by Mr. Warde's chief assistant, Mr. P. J. Sims, and Mr. Warde suitably replied. Mr. Warde goes to his new sphere in the Antipodes, followed by the best wishes of a large circle of business friends in all parts of Scotland.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

A new arc lamp is being tried in Berlin, invented by M. Riglio. It is a rotary current lamp with four electrodes. Three form the lower pole and are connected with the phase conductors. Each is 8 mm. in diameter, and they are from 12 to 15 mm. apart. The fourth is the neutral upper pole and is 20 mm. in diameter, and placed centrally over the others so that three craters form above and three below. The consumption of the upper pole is very small, and the light is said to be well diffused. The connection with the differential regulator is effected in the following way: the current coil is connected with one of the phase conductors and the tension coil with the two others, by shunt winding. The lamp is intended chiefly for a small number of periods, under 25, in fact.

Induction Coils for Heating Liquids.

Another invention arousing attention is an apparatus designed by M. Ponzini for heating liquids on the vortex current principle. A hollow iron cylinder 632 mm. long (say 2 ft.) and 35 mm. in external diameter is wound with 2,000 copper wires, each 1·2 mm. in thickness. Their ends are connected with a transformer. Inside the cylinder is a cooling tube through which water is passed. If the voltage is kept between 200 and 1,200 cosign ϕ varies from 0·7 to 0·79 unless 70 grooves each measuring 2 × 2 mm. run over the cylinder at right angles to the lines of force. They are 7·5 mm. apart. They increase cos ϕ to 0·94 forfthe same energy expenditure, and to values between 0·82 and 0·92 if they run longitudinally.

Atmospheric Effects on Insulators.

Some very important results have been obtained by Dietrich, of Gottingen, and deserve the attention of your readers. The resistance of the insulator was measured under the various conditions by the loss of charge from an electroscope. Light, especially the ultra-violet rays, has a great effect on ebonite in the presence of atmospheric oxygen covering it with a conducting layer. Indiarubber, paraffin, and sealing wax are similarly affected, but to a much smaller degree. Moist air covers sealing wax, paraffin wax, resin, and shellac with a conducting layer. Wax, vulcan fibre, vulcan asbestos and Isostabile are very hygroscopic. The behaviour of porcelain in this respect is uncertain. In the case of wood there are two determining factors, the kind of wood and the speed with which it absorbs moisture. Hence we get the following two series, in each of which the woods are arranged in descending order of insulating power:

1. Pine, walnut, fir, beech, oak.
2. Oak, walnut, pine, fir, beech.

Glass varies greatly, the same pieces often behaving differently after only a short lapse of time. The reason is unknown, but it has been suggested that internal crystallisation may be caused by the electric current. In all insulators, as the temperature rises, the insulation falls off in the interior of the substance and rises on the surface.

New Regulating Resistance for High Powers.

It is well known that the regulating resistances shunted into the circuits of electric furnaces are far from being satisfactory. Thiele, of Strassburg, has invented one which seems satisfactory in every respect. The principle of it is the use of running water as a resisting material. It takes up and carries forward the heat developed. As the temperature of the outflow can be regulated at will by changing the quantity of water passing, the strength of the electric current can be regulated within wide limits. The apparatus consists of an open box of oiled oak with sides one cm. thick. A longitundial partition divides it into two parts, one narrow (2 to 3 cm. wide) and one occupying the rest of the interior. The partition does not reach the bottom of the box by about 2 cm. In the partition and in the box sides opposite to it there are vertical grooves about 2 cm. wide and 5 cm. deep and 1 cm. apart. These grooves hold lead plates 1 mm. thick, which stop short of the bottom like the partition itself, so that a clear space 2 cm. high is left over the whole of the bottom of the box. A wooden shelf prevents the plaets from falling down. The plates are connected alternately to two brass bars supported on wooden pillars a few centimetres above the sides of the box. The current is thus transmitted to the plates in such a way that two contiguous plates are always opposite poles. The water passes between the plates through holes in an iron pipe running between the brass rails and parallel to them. The whole arrangement evidently acts as a resistance box, its resistance being the greater the colder the water. It is usually necessary to regulate the depth of the water in the box as well as its rate of flow, and this is easily done by having the outlet holes at different heights.

Company Notices.

Two large German electric tram companies have just issued their reports for 1909. The Stettin Co. carried 17,682,671 passengers as against 17,052,594, and the average receipts were about 6d. per car mile. The net profit was 356,000 marks, of which 33,000 marks go to the town, 300,000 to pay a 7½% dividend (the same as in 1908), and 6,000 are carried over.

The Coblenz Co. carried 7,803,483 passengers, as against 7,664,344, and the average receipts were about 6¼d. per car mile. The net profit was 336,783 marks, as against 294,251. 1,426 marks are carried over, and a dividend of 7½% is paid on the capital of four million marks.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The provisional programme for the meeting in England of the American Society of Mechanical Engineers in July next is now complete. The party will leave here in the *Celtic* on July 16, and arrive in Liverpool on July 25, leaving by the noon train for Birmingham, where they will be welcomed by the British Institution of Mechanical Engineers. On Tuesday, the 26th, the Lord Mayor of Birmingham and members of the Local Committee will receive and welcome the president, Mr. George Westinghouse, and the officers and members of the Society, and the reading and discussion of papers will follow. After luncheon at the Town Hall there will be visits to Stratford-on-Avon, Worcester, Gloucester, and Bournville, and to local works; and in the evening there will be a garden fete. Wednesday forenoon will again be devoted to papers and discussions, the afternoon to visits to the University and local works, and in the evening there will be a reception at the Council House. Thursday morning will be given over o visits to Coventry, Rugby, Warwick, Leamington, Kenilworth, and Lichfield, and then a special train will take the party to London, where there will be an Institution conversazione. Papers on the electrification of railways will be read on Friday morning, there will be garden parties in the afternoon, and a banquet at the Connaught Rooms of Freemasons' Hall at night. On Saturday there will be river excursions to Windsor and Henley, and in the evening a reception at the Garden Club in the Japan-British Exhibition.

Mr. Finch's Problem.

A month ago one of these Notes was devoted, under the head of "A Problem for Electricians," to the page advertisement in which Mr. Robert C. Finch, president of the Colonial Illuminating Company of New York, announced, with a prodigal wealth of capital letters, that he had succeeded in Perfecting a Line of Invention that would Increase the Net Earning Power of Electric Lighting Plants

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at Least Fifty Per Cent., and, in most cases, One Hundred to Two Hundred Per Cent. Annually. Mr. Finch, it may be remembered, further announced that " this invention Will Not be Commercialised in any manner. This invention not for sale until such time as we have Proved Absolute Commercial Worth to One Thousand Electric Light Plants (Municipal and Private) in the United States. All that the inventor is seeking to-day," it was added, " is the Honour, holding the personal right to Anticipate, but not to Equal—What Mr. Edison and Dr. Isadore Kitsee is to Electricity, Mr. Carnegie to Steel, Mr. Rockefeller to Oil, Mr. Morgan to Finance, Mr. Clark and Mr. Lawson to Copper, Mr. T. P. Shonts to Railroads and Subways, Mr. Paul Morton to Life Insurance, United States and Abroad, Inventor will be entitled to, at least, the Honour of Shedding Light on One of the Best Electrical Opportunities, plus more light in reading the Bible, by those that Need to Most (Hypocrites Excepted). One Month From To-Day," said Mr. Finch, " Every Newspaper in the United States will possibly ' Head Line ' this invention. (My name will not be mentioned if I can prevent.) Every Man, Woman and Child in the United States will be Benefited Directly by this Invention. It is made by Electricity, Air and Water, purified by Electricity. Two to Four Hours ' Off Peak Load Daily ' Electric Light Plants all that is necessary. $2,000 to $10,000 is the actual Cost of additional equipment." Well, the month has expired, and though every newspaper in the United States has not risen to the opportunity of head-lining the invention, the technical journals have at least come out with further pages of advertisements in explanation of Mr. Finch's great idea. The Mystery, in Short (to adopt Mr. Finch's method) is Out. It is a case of electrolyzed water, not only as a deodorizer, disinfectant and germicide, but also as a fertilizer.

For Humanity's Sake.

" For the Sake of Humanity," writes Mr. Finch in this second announcement, " if for No Other Reason, Central Station Plants Should Support and Assist in the Development of this Opportunity. There is a Humane Reason Why Electrolyzed Water, Air, Garbage Should Receive Your Serious Consideration, Regardless of Any Monetary Consideration by Electric Light Plants, or to the Inventor and Writer of this Advertisement. Three Expert Electro Chemists (One Having a National Reputation) Assisted in this Development 1898–1910. Full Information, Technical, etc., in Our Prospectus, Which is Clearly Written and Illustrated." And elsewhere he says " Garbage Converted Into Fertilizer by Electricity, Air and Water. Water Purified by Electricity and Air. Air Purified by Electrolyzed Water. Absolute Disinfectant, Germicide, Deodorizer and Fertilizing Process. Positive and Effective at All Times, Under Any and All Conditions. Electrolyzed Water flowing to Sewers from Street Sprinkler, will Deodorize Sewer, also Kill All Bacteria Life. (1-Gal. E. Water to 100 Gal. Sewerage.) Fertilizer. Electrolyzed Process. Trade Mark. Garbage—Store, Hotel and Residential, converted into Fertilizer. This system produces Fertilizer Equal, if not the Best, to Any on the Market for Farm Land, Gardens, etc. Chemicals not necessary in this process to produce the rich neutrals soil requires. The richer the Garbage, the Better the Fertilizer. Electricity, Air and Water, with Solid Matter—Electrolyzed—Back to Earth, Replenishes, etc. Sold in Sacks, Barrels or Bulk. Listed with Wheat, Planted with Corn, Cotton, etc. Price to Consumer not to exceed $10·00 per Ton (Note price Chemical Fert.)." So there is the whole matter now in front of the reader. If it is still somewhat cryptic here and there, Mr. Finch is willing to accept all the blame. " To the skeptical, and others," he writes, " who see fit to criticise our manner of advertising, will say—Blame Me, and Not This Publication. I will pay $10,000·00 annually to an Advertising Manager Who Can Write Better Copy. Anyhow, Mr. Critic, the Merit of this proposition does not deserve adverse criticism. Please send for my " Evolution of a Knocker.' If You Own An Electric Light Plant, You Will Make a Contract With Us, This Year or Next. If you are competent to judge, and have the executive ability required, we can show you an opportunity to Buy, very Profitably, one or more Electric Light Plants. (They cannot buy our system, account bad management.) It is to Your interest to take advantage of a very successful commercial opportunity." After this there seems nothing more to be said.

New Electric Cookers.

Two electric cookers of new principle and design have just been placed on the market here. The " Quad " fireless cooker, made by the A. L. Sykes Manufacturing Company, of Cincinnati, is a vertically-placed cylinder of appropriate dimensions, consisting of four sections or compartments fitting over each other, of which the lowest is intended for the joint, the next for vegetables, and the two upper compartments for pastry or fish or savouries or fruit; or the two lower compartments can be used respectively for meat and poultry. These cylindrical cooking compartments, or as many as are required, are superimposed on an electric stove of circular design, and over them is placed, in such a manner as to be airtight, a hood or cylinder of insulating material. The current is then switched on and the cookery process is put in action with the minimum of trouble and expense. It is claimed that the " Quad " will perform every kind of culinary operation at a cost materially less than that of gas, inasmuch as the heat generated cannot radiate or escape, and is utilised to an efficiency point of 100%. The other stove is manufactured by the Hughes Electric Heating Company, of Chicago, and it is claimed for it that it gives an abundance of steady heat for all kinds of cooking, baking and other work just as is required of the ordinary kitchen stove. It is strongly made for hard usage, having steel body and legs, finished in hard-baked black japan and tastefully decorated, is easy to keep clean, takes up very little space, stands in any position, and can be moved at will. It costs no more than an ordinary gas stove, and works equally well on either direct or alternating current. It is made for all commercial voltages, up to 220 volts and the heat may be instantly controlled by the operator. One can have a small fire or a large one at will, or both at the same time if desired. The stove is so constructed that by the use of a three-heat switch three degrees of heat for each burner may be obtained. The current consumption for the first heat is 150 watts; for the second heat 300 watts, and for the third heat 600 watts. If desired a steel oven large enough for baking bread can be furnished. There are no burners to clean and no dirt to hinder the flow of heat. The burner, it is claimed, produces quicker results with less consumption of current than any other, due to the method of construction. An absolute guarantee is given to renew the heating element if it burns out within one year. The base of the heating element is 8½ in. in diameter, and is made of a special composition of the company's manufacture. The wire is a patented alloy and is practically non-oxidizable.

New Resistance Alloy.

A new resistance alloy is being placed on the market by the Electrical Alloy Company of Morristown, New Jersey, under the name of " Nico." Its special claims are high and permanent resistance, and low temperature co-efficient, and it is guaranteed to be non-oxidizable, non-corrosive, and indestructible. As it is furnished in every variety of wire, it is of especial value for use in controllers, heating apparatus, arc lamps, telephone coils, and all other apparatus where a non-corrosive material, having a very high resistance, is required. Nico contains no iron and is specifically recommended for use in resistances exposed to abnormal atmospheric conditions or moisture, as well as for use in rheostats where the amperage is high and the rheostat is subjected to severe conditions of overloads. It gives superlative results where it is important that the operating temperature shall be kept at a minimum degree of heat when the apparatus is under heavy strain. Nico would appear to be a further development of the resistance conductor so long and so favourably known as " Nichrome," which is also non-corrosive and non-oxidizable, has a specific resistance equal to mercury, 600 ohms per mil. ft., with a temperature co-efficient of ·00024 per °F. and a melting point above 2,800 °F.

Three-Phase or Single-Phase?

Writing on the Electrification of Railways, in the *Electric Journal*, Mr. N. W. Storer arrives at the conclusions: (1) that systems can be compared only by eliminating all differences that are not inherent; (2) that three-phase will give very satisfactory results where the speeds are uniform and low or moderate, and especially for work on heavy grades where the advantage of light weight is greatest, and

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the automatic regeneration of power serves to hold the train back in descending grades; (3) that the single-phase system is able to meet practically any conditions of operation in general railway service, and that it is superior where a variety of speeds and especially high speeds are required and where the simpler overhead construction is especially desirable; and (4) that neither of the alternating-current systems would be necessary or desirable, if direct current at 600 volts could be collected from a distributing system, including sub-stations and contact conductors, as simple and cheap as that of the single-phase system. As a matter of fact, a careful examination of three-phase, single-phase and direct-current installations in this country and in Europe shows the utter futility of comparing the systems on the basis of present installations, since in every case the installation has some peculiar condition to meet which renders it unfit for comparison as to system, even in the most general terms. It is, for instance, unreasonable to compare the cost of the New Haven construction with its very substantial bridges and double-catenary suspension with that of the Simplon tunnel. If the simple construction of the latter, which is so light as to appear flimsy in the eyes of an American engineer, is safe for three-phase, it should be equally safe for single-phase, which is inherently much simpler, lighter and cheaper than three-phase. The light construction with direct suspension of the trolley wire at the Simplon tunnel, is apparently satisfactory for the slow and moderate speeds in use on all three-phase installations. If higher speeds were contemplated, catenary construction would be advisable if not absolutely necessary.

Incorrect Comparisons.

Mr. Storer points out that it has been customary to give the three-phase system the credit for all the advantages in light weight, due to the peculiar construction employing the Scotch yoke for connecting the motors to the driving wheels, and for the very light design of mechanical parts, but the fact is that these features are not inherent with three-phase locomotives, and may be used to the same advantage with single-phase or direct-current locomotives. They have not been adopted in this country, because they have certain disadvantages which, in the eyes of American engineers, offset the advantages. It has also been customary to credit the three-phase system with all the advantages of the single control system in use on most of the three-phase locomotives. This also is a mistake, since if this control will meet the conditions of service satisfactorily with three-phase, the same type of control will give better operation with single-phase, and will be cheaper, simpler and more efficient than when used with three-phase. In comparing the service capacities of different types of locomotives, it is customary to speak of the enormous horse-power rating of three-phase locomotives, forgetting that the rating of the three-phase locomotive is given at its maximum speed, while the ratings of the single-phase and direct-current locomotives are usually given at less than half their maximum speeds. Thus, the 071 locomotive built for the New Haven road has a tractive effort for one hour of about 18,000 lbs.; its normal speed on level track is about 45 miles per hour, and it frequently reaches 50 miles. A three-phase locomotive having these characteristics would be called a 2,400 h.p. locomotive, and yet it would have practically no greater service capacity than the 071 which is rated at 1,600 h.p.

ELECTRICAL PROGRESS IN INDIA.

(From Our Indian Correspondent.)

Bombay.

An important development is announced in electrical work in India in the statement that H.H. the Nizam has been pleased to sanction a scheme for the supply of electricity in Hyderabad for lighting purposes. At present the supply is restricted to certain parts, viz., Chudderghat, Saifabad and Kiratabad. It is, however, hoped that in course of time it will be extended. The scheme owes its origin to Mr. Gamlen, the present Mint Master, who is to be congratulated on the service he will be doing to the public by its introduction. The power is to be generated from the mint, whose engines can be used for minting during the day and for generating electricity for lighting purposes during the night, so that they will be made to serve a double purpose which would otherwise entail a high cost on the Government.

The Callender Cable Construction Co. have undertaken the contract from the Government for laying the electric mains, and have already commenced work. Messrs. Osler & Co. have undertaken the lighting installations in private houses. The erection and conversion of the plant at the mint itself is being done departmentally. The charges for lighting, etc., will be as low as those which obtain in the presidency towns, as much of the cost will be saved by utilising the mint plant. It is expected that the supplies will be started before the end of August.

Other important announcements made during the past week are that the Finance Sub-Committee of the Lahore Municipal Committee has recommended that the Municipality should undertake an electrical scheme for Lahore, and that an electrical license has been granted to the Simla Municipality. Last Sunday a trial was made of the electric light installation on the Mall from the Club to the Library, the motive power being supplied by the United Service Club. This was in the nature of an experiment, undertaken to ascertain the cost of lighting the station with electricity.

EDUCATIONAL.

GLASGOW UNIVERSITY.

During the winter Session, commencing in October, two classes in Electrical Engineering are held under the Faculty of Science. Each class meets on three days of the week, a thoroughly practical course being worked through. An Electrical Laboratory, being part of the new James Watt Engineering Laboratories, is open daily for experimental and research work. The fees for each class is two guineas. Some slight modifications are, we understand, contemplated for next Session, but these have not yet been issued.

ASSOCIATION OF ELECTRICAL ENGINEERING STUDENTS, L.C.C. SCHOOL OF ENGINEERING, POPLAR, E.

The third meeting of the above Association was held on Wednesday evening, the 22nd inst., when a debate on "Gas *versus* Electricity" took place before a large audience. Gas and electricity, for power, lighting and heating, were thoroughly discussed. Mr. H. E. Newton was the proposer of Gas, and Mr. M. F. Allsop, the seconder; while Mr. G. K. Tweedy defended Electricity, seconded by W. Brading. The following gentlemen took part in the discussion: For Gas—Mr. Nesbit, W. P. Winter, B.Sc., W. W. S. Ibbetson, B.Sc., A.M.I.E.E. (staff members), A. Malit and A. J. Reeves (student members). For Electricity—Mr. H. A. Garratt, M.I.N.A., A.M.I.C.E. (President), J. Paley Yorke, F.Ph.S.L. (staff members), B. J. Herbert, C. Colling and E. A. Martin (student members). Electricity came out triumphantly by a show of hands.

NORTHAMPTON POLYTECHNIC INSTITUTE.

Aeronautics.—The silver medal offered by the Women's Aerial League to the best student in the pioneer courses in Aeronautics held during the session 1909 10, has been awarded to Mr. Duncan George, Mr. E. R. Moffat being *proxime accessit*. In continuation of the above successful evening courses, extended courses of a more complete and practical nature are being arranged for next session, and Mr. F. Handley Page, of the firm of Messrs. Handley Page, Ltd., the well-known aeronautical engineers, has been appointed to take charge of these courses. Full details will be announced shortly. In addition, there is under consideration the establishment of full-time day courses in Aeronautical Engineering extending over four years, and similar to the well-known day courses in Electrical and Mechanical Engineering established some years ago. A preliminary announcement has already been made in connection with these day courses, and fuller particulars will be ready shortly.

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Business Notes and News.

LIGHTING AND GENERAL—Home.

BURNLEY.—The Corporation Electricity Department has made a profit of £4,147. This is a slight decrease on the previous year, in spite of a bigger revenue, but there was more to pay in interest and for sinking fund. £3,500 has been paid over in aid of rates and £647 placed to depreciation account.

CARDIFF.—The Corporation Electricity Department shows an increase of £1,241 in revenue from lighting, in spite of keen competition from the local gas company.

GORSEINEN.—The Glamorgan County Council are petitioning against the Gorseinen Electric Lighting Provisional Order.

HULL.—The Corporation's Electricity Department had for the past year a revenue of close upon £54,000; this shows a slight decrease, but it is healthy to find that the revenue for power has increased by £2,500. The works costs have been reduced to ¾d., and the total costs to 1d. per unit sold. During the year additional generating plant has been laid down, and a large percentage of the mains renewed.

LEEDS.—Flame arc lamps are largely responsible for the fall in amount paid for street lighting, but what is a loss to the electricity department in this instance proves a gain to the whole community, and flame arc lamps are being put up in several additional streets, including New Briggate.

LEICESTER.—It has been decided to appoint a gas engineer and manager to replace the late Mr. Colson. As regards the electricity department, it is now being considered whether a chief engineer should not be appointed to take control of the tramway and general generation stations, and to administer the whole department.

LLANDUDNO.—At the monthly meeting of the Council the Electricity Committee recommended the Council to grant an increase of £5 with further increases of £5 per annum from the beginning of each financial year until the sum of £300 a year be reached, which sum shall be considered the maximum for the post. This was carried unanimously.

LONDON: HACKNEY.—There is not to be an increased use of gas for street lighting. What has occurred is this: the Borough Council have entered into a five years contract for the continued use of gas in some of the less important streets, where electric mains have not been laid down, the gas company having offered exceptional terms in order to secure a long agreement.

LONDON: ISLINGTON.—The return of the Borough Electricity Department for the year ending March 31 is most satisfactory. £3,027 of surplus profits have been placed to reserve, and while there has been a drop of £439 in revenue from ordinary private lighting, there was an increase of £526 from the lighting of churches, theatres, etc., and an increase of £1,179 from day lighting and power. The total revenue was £53,134. The works costs have been reduced from ·90d. to ·77d. per unit. The demand for motors and radiators is steadily increasing. During the year a loan of £15,000 was taken up and £2,747 taken from reserve for extension purposes, including a new turbine and accessories and the laying of over 53 miles of additional mains.

LONDON: ST. PANCRAS.—It is proposed to lay down an additional boiler at the Borough Electricity Works to cope with the coming winter extra load, and tenders will shortly be advertised for.

MONAGHAN.—As the result of a ratepayers' vote it has been decided by the Urban Council to consider the proposed town electric lighting scheme.

OLDHAM.—On a gross revenue of over £42,400 the Corporation Electricity Department made a net profit of £2,203 last year. Mr. S. W. Newington has succeeded in reducing the total cost of production from ·910d. to ·908d. per unit, notwithstanding a fall of over 300,000 units sold.

TREHARRIS, WALES.—An extensive electrical installation is now in operation at the Deep Navigation Collieries here. Electricity is used for lighting, winding and hauling.

TWICKENHAM.—The Twickenham and Teddington Electric Supply Co., Ltd., are about to lay down cables and boxes for connecting up in Richmond-road from Morley-road to the Skating Rink, and from Twickenham-park to Park-road.

LIGHTING AND GENERAL—Overseas.

DORDRECHT.—The city authorities have decided to construct an electrically driven swivel bridge, the cost of which is estimated at 98,000 florins (£8,166).

LLOYDMINSTER, BRITISH COLUMBIA.—After being closed down for over 18 months the electric light plant has been finally reopened, and electric light is once more a reality. All difficulties in the way of operating the plant have been removed, satisfactory arrangements having been made with the former owners. W. Johnson, a local business man, is the new owner of the plant.

PORT PIRIE, SOUTH AUSTRALIA.—The Lighting Committee of the Municipal Council have reported in favour of electric lighting for the town, and advising the appointment of an expert electrician to carry out the project. The Municipal Council have adopted the report.

WINNIPEG, MANITOBA.—The British Empire Trust Co., Ltd., notifies that the Winnipeg Electric Railway Co. has declared a dividend at the rate of 10% per annum for the quarter ending June 30, on the capital stock.

TRACTION—Overseas.

MADRID.—The Office of Public Works have granted to the Sociedad Tranvia de Barcelona á San Andrés y Extensiones a concession for the construction and working of an electric tramway from the Calle de Caspe, Barcelona, to Vallcarca *viâ* the Calle de la Industria.

COMPANIES' MEETINGS AND REPORTS.

GLOBE TELEGRAPH AND TRUST.

The Marquis of Tweeddale, presiding at the meeting of the Globe Telegraph and Trust Co., Ltd., at Electra House, said the report and accounts must be regarded on the whole as very satisfactory. The net revenue after deducting expenses, amounted to £209,117, an increase of £1,770, from which there had to be distributed £131,085 in interim dividends. The dividend on the Ordinary shares for the year amounted to 5⅞%, as compared with 5¾% last year. They were also carrying forward £400 more than last year.

ARON ELECTRICITY METER.

The 13th ordinary general meeting of the Aron Electricity Meter, Ltd., was held at Winchester House, Old Broad-street, London, E.C., on Friday, 24th inst.; Mr. H. Hirst, M.I.E.E. (Chairman of Directors) presiding.

In moving the adoption of the Report for the year ended March 31, particulars of which appeared in our last issue, the Chairman said: It is once more our pleasure to submit for your approval the Report of a year's trading. The similarity of the figures in the balance sheets of 1909 and 1910 shows that our business has attained a pleasant stability. But profits have risen in this year's accounts to the satisfactory total of £35,630, being £1,330 more than last year, which was up to that time our record year. The other items on our Profit and Loss Account are within a per cent. or two the same as last year. We have written off £400 more for depreciation, not because our plant is in any worse a condition, but in an industrial business, which is constantly in process of evolution, one likes to use some of the profit of good years for writing down certain capital items. Maintenance of Patents is a few hundred pounds less, and so, naturally, is debenture interest—for our debt decreases every year by the annual repayment of about £5,000. As regards the balance sheet only two figures call for comment. We have added to our leasehold land, buildings, machinery and tools the sum of £9,279, this figure being largely composed of additional land and buildings rendered necessary by the increase of our business. We have less cash to the extent of £15,000, if I include loans at short notice. This is accounted for by the greater trading outstandings, which are £58,000 this year as against £40,000 last year, and also to some extent by the extensions of the taximeter business. The taximeter business particularly is at present absorbing capital. These instruments, as I have already stated, are not sold outright, but hired out, mostly, for periods of about five years. We have received very satisfactory contracts in London, Brussels and Vienna for hiring out taximeters, and while we have to manufacture and instal every instrument, the cost of both manufacture and installation has to be defrayed at present from our liquid assets. Payment, however, is renewed only with monthly or quarterly instalments, and it follows that the outgoings so far as capital expenditure is concerned are still greater

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than the incomings, and this state of affairs is likely to continue for some time if we are not successful in obtaining more orders. The profits we have shown in this year's accounts have been made entirely by our old established meter and clock business; for the safety of the company the directors have so far used all the income received from taximeters against manufacturing and installation expenses. It is a matter of great satisfaction to the Board, particularly to Professor Aron as managing director, and to myself as chairman, that we are able this year to recommend the distribution of a dividend which will clear off the last of the arrears due to the Preference shareholders. Our conservative policy, which necessitated in years gone by the accumulation of these arrears, has been vindicated, not only by our ability to pay them back now, but also by having a business which shows a greater turnover and profit than at any time during its existence. We are firmly planted in nearly every European country, and we have found a particularly useful outlet for our manufactures in the constantly growing and prosperous power companies on the continent. The average yield per meter is less than in former years, but we have made up for this by selling a very much larger number of meters. I can only add that I sincerely hope, and there is great reason for that hope, that the ordinary shareholders will, in the near future, be rewarded for their great patience. Before putting the motion for the adoption of the Report and accounts to the vote, I wish to express my pleasure that Professor Aron is able to be present at this year's meeting, and I am anxious to take this opportunity of thanking him for the hard and great work which he has given unstintingly to our company and which has been the mainspring of our success. He has been loyally backed up by our excellent staff, whom he has placed in charge of our various undertakings in the different countries, and their efficiency and loyal and strenuous work is greatly due to his master mind which has controlled them. I have much pleasure in moving that the Report and accounts as presented to the shareholders be received and adopted.

Sir James Pender, Bart., briefly seconded, and the motion was carried unanimously. The requisite resolution for the payment of the dividend on the Preference shares was then passed.

Mr. Roger W. Wallace, K.C. proposed the re-election of the retiring directors, Mr. H. Hirst and Sir James Pender, Bart. In a trading concern of that kind it was extremely desirable, he said, that the head of it should be someone in a position such as Mr. Hirst so successfully occupied.

Mr. Harry Kahn, in seconding, paid an eloquent tribute in appreciation of the chairman's services in behalf of the company.

The motion was heartily approved.

The auditors, Messrs. Price, Waterhouse & Co., were duly re-elected.

The meeting closed with the customary compliments.

COMPANIES REGISTERED.

LEAKE-SUMNER GUN FIRE CONTROL SYNDICATE, LTD.—£1,500, in £1 shares. Business: Engineers, manufacturers of and dealers in apparatus used in connection with electric signalling, etc. To acquire from H. C. Leake and O. Sumner and turn to account certain inventions relating to gun fire control, and improvements therein, etc. Private company. Office, 39, Victoria-street, Westminster.

WHITEHEAD BROS., LTD.—£12,000, in £1 shares, to carry on the business of engineers, founders, smiths, electricians, workers of and dealers in electricity, motive power and light, etc. The subscribers are W. Whitehead, Ada Terrace, Bogley-lane, Rodley, ironfounder; H. Whitehead, 13, Priesthorpe-road, Farsley, ironfounder; J. Whitehead, 8, Central-avenue, Little Horton, Bradford, founder; and F. Whitehead, 9, Hildathorpe Terrace, Priesthorpe-road, Farsley, founder.

PERSONAL.

The Keighley Town Council have appointed Mr. Harry Webber, of Sunderland, as Borough Electrical Engineer, at a salary of £250 a year, in succession to Mr. Smyth, who is resigning on account of his health. Mr. Webber is at present assistant electrical engineer at Sunderland. There were originally 123 applicants for the post.

Mr. H. D. Johnston, E.E., C.E., has been appointed Toronto representative of the Canadian British Insulated Co. Mr. Johnston was formerly connected with the National Electric Construction Co. of England. Although the head office of the Canadian British Insulated Co. is in Montreal, the managing director, Mr. Lawford Grant, E.E., spends considerable time in Toronto, having completed several large cable installations in that city.

It appears that Mr. Noel Woodhouse, electrical contractor, of Liverpool, is over in Canada looking over the field with a view to enlarged business.

The Devonport Electric Power Committee have decided to recommend an increase of salary to Mr. J. W. Spark, their electrical engineer, from £300 to £350, by two annual amounts of £25 each.

At the annual meeting of the Electrical Employers' Association of New South Wales, the following officers were elected for the ensuing year:—President, Mr. E. J. Erskine; vice-presidents, Mr. A. J. Hanson, Mr. J. E. Donoghue; treasurer, Mr. G. R. Hodson; committee, Messrs. A. Waddell, H. W. Ramsay Sharp, W. M. Arnot, J. D. Handley, W. A. Purdom; auditors, Mr. E. M. Gibbes, Mr. G. T. Stowe; secretary, R. Burgin.

The Greenock Corporation have increased the salary of Mr. J. A. Robertson, their electrical engineer, by £50, bringing it up to £500. It was shown that Mr. Robertson had not made an application for such an increase, but he had applied for a post at Salford, and it was in the interests of the burgh, considering the immense amount of new work, that his services should be retained.

Mr. Harold Morse, electrical engineer at the Penrikyber Navigation Colliery, has obtained an appointment with the Vancouver Electric Light Co., British Columbia.

As the result of Mr. C. W. Salt having recently resigned his position as chief assistant electrical engineer of the city of Bradford to take up the position of chief electrical engineer of the Torquay Electricity Undertaking, the Bradford City Council, acting on the recommendations of the Electricity Committee, have made the following appointments:—Mr. Harry S. Ellis, assistant electrical engineer, to be deputy electrical engineer and manager; Mr. J. H. Schnauber, chief draughtsman, to be assistant electrical engineer.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work enlargely.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

Answer to *Question No.* 1,217 (*awarded* 10*s.*).— A reasonable assumption for the over-all efficiency (bus bars to loco. wheels) of a short distance electric railway would be 70%. In all but the most exceptional cases the generator voltage would be transformed up to a suitable pressure for transmission to the sub-stations (11,000–30,000 volts). At the sub-station, step-down transformers would reduce the pressure to 3,000 or 6,000 volts (trolley volts), the final reduction to 500 or 1,000 volts being effected by static transformers on the trains. In exceptionally short lines a trolley voltage of 500–1,000 volts would be used and the train transformers so avoided. Assuming the latter condition to hold good in the present instance, the station and sub-station transformers may be taken to have 97½% efficiency; the lines between station and sub-station and between sub-station and trolley wheel (or 3rd rail plough) may be taken to have 92½% efficiency each: the train cable system and motors have under normal conditions an overall efficiency of 90% and the gearing

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has 95% efficiency. The efficiency from bus bar to draw bar is then 69·6%. Every 100 units of power delivered to the generator bus bars is distributed as shown in Table I.

Considering the efficiency right back to the prime mover, and assuming a boiler efficiency of 80%, a pipe-line efficiency of 90%, a thermal efficiency of steam engine or turbine = 20%, and a generator efficiency of 95%, it will be seen that 13·7% of the energy of the fuel is delivered to the generator bus bars, and that only 9·52% ultimately reaches the locomotive draw bar. If water power be the prime mover the corresponding over-all efficiency (prime mover to draw bar) is much greater, say 58½%, since a water turbine will yield 85% theoretical water power available.

TABLE I.

	Power Delivered.	Loss at each step (as % total input).
Generator Bus bars	100 units	—
Termls. step up transformer	97·5 „	2·5% in transformer
H.T. Sub-station termls. ..	90·2 „	7·3% in line
L.T. „ „ ..	87·9 „	2·3% in transformer
Trolley wheel or 3rd rail plough	81·4 „	6·5% in line
Motor shaft	73·3 „	8·1% in cables & m't'r
At track wheel	69·6 units	3·7% in gearing
	Total loss	30.4% bus bar to draw bar.

The line efficiency may fall to 90 or 85%, but should not be allowed below this limit.

A typical example, supporting the above general analysis, is the case of the Great Northern Railroad Co. (an American trunk line). The Cascade Tunnel, 13,900 ft. long and 1·7% gradient, is electrically operated by 6,000 volt three-phase current from 30,000 volt sub-stations (loco. motors are 500 volts—4 per loco., fed from static transformers on the car). The motors are 375 h.p. (475 h.p. for 1 hour), run at 375 r.p.m., and are geared 4·26 : 1 to 60 in. drivers (giving a speed of 15–16 miles per hour). Train weight excluding locos. = 1,610 tons.

The losses when delivering 4,000 kw. to the locos. at the end of the tunnel remote from the sub-station are :—

	Power Delivered.		Losses each stage.	
	K.watts.	%	K.watts.	% input.
Power house l.t. bus bars ..	4,740	100%		
			490	10·3%
Sub-station l.t. bus bars ..	4,250	89·8		
			250	5·3
Loco. Trolley wheel	4,000	84·5		
			680	14·4
Loco. driving axle	3,320	70·0		
				30·0%

ANALYSIS OF CAR LOSSES.—The total energy loss between the trolley or live rail collector and the loco. draw bar may be regarded as composed of acceleration, rheostatic, motor windage and friction (axle and rail) losses. This total car loss is nearly proportional to the car weight over a wide range of the latter. In the case of 32 and 16 ton cars respectively (Case I. below) the total losses were 528 and 276 watts under the conditions cited (Ayres).

A quantitative analysis of the total car losses in the following two cases (Ayres) is very instructive :—

Case I.—Boston Elevated Railway : 4.GE. 202 motors per loco. ; gear ratio 4·73 ; 6 stops per hour ; schedule 12 m.p.h.

Case II.—Standard pattern of car : weight 82,000 lbs. 4.GE. 73 motors per loco.

Car Losses :—

	Case I.	*Case II.*
Acceleration	65·5 to 62·5	60·0
Rheostatic	13·3	9·5
Motor	15·2	17·0
Windage	1·0 to 2·0	3·5
Friction	5·0 to 7·0	10·0 (track + bearing)
	100·0	100·0

On a 40–50 ton car, roller bearings reduce the friction losses by 30–35% at speeds of 30–50 m.p.h. Below 30 m.p.h. the saving decreases rapidly.—" WREN."

OSRAM TRAIN LIGHTING.

It is not necessary to be an expert in lighting matters to appreciate the wonderfully good illuminative effect obtained by the arrangement adopted for the interior lighting of cars on the Waterloo and City Railway. The general result is undoubtedly good, and in this direction it is interesting to note that a lesser number of points per car are used than any other of the tube railways in London. The method adopted by most other railways is that of arranging the lamps along the roof of car on each side, immediately above the heads of the passengers. The Waterloo and City Railway run their lights from the centre of roof, 26 fittings being utilised for each four-car train, each of the larger cars taking seven 55 watt Osram lamps, and the smaller

cars six 55 watt Osrams, each independently arranged in special opalite globe, which permits of a considerable volume of light being thrown on to the white enamelled roof; this, by its peculiar shape, acts as a very efficient reflector, and thereby naturally causes considerably increased illuminative effect. The lamps are burned four in series, and have now been installed since June, 1909. Upon enquiry, we find there have been very few failures, and that a great many of the original lamps are still in use, burning with undiminished candle-power. It will be quite appreciated that the vibration in these trains must necessarily be somewhat severe, but this appears to have no adverse effect whatever on the Osram lamps.

SOME SIEMENS' NOVELTIES.

Messrs. Siemens Bros. & Co., Ltd., have brought out three new publications. Pamphlet No. B 517, " The O.S. Electric Wiring System," consists of a more or less popular description of this method of wiring, and includes illustrations of actual surface " Stannos " runs, as well as a series of pictures of all sorts of buildings that have been wired with " Stannos." It has been prepared chiefly for architects and prospective consumers, and in this connection should form useful propaganda for electrical contractors, station engineers and others. Catalogue No. 502, " Thermo-Electrical Pyrometers," which supersedes that of October, 1907, and contains various new features in connection with the well-known Siemens thermo-electrical pyrometers. In addition to certain modifications in the thermo couples and protecting tubes, Messrs. Siemens have added some new temperature indicators and recorders, both of which instruments are now supplied with suspended or with pivoted coils, and minimum and maximum temperature alarms, with retardation relays, are described for attaching to the temperature recorders. Reprint No. 517D, " Concentric ' Stannos ' Wiring at Cambridge Colleges," describing some recent installations of concentric " Stannos " wiring at certain Cambridge Colleges, where the valuable and antique nature of the architecture and decorations could not have been negotiated inexpensively and neatly by any other system of wiring.

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PATENTS.

Electric Motor Control.

12047.—1909. British Thomson-Houston Co., Ltd., London. This is an improvement in electric motors for operating pumps to store energy in an accumulator. An electrically controlled device is provided for tripping the circuit breaker in the motor circuit. This device is interlocked with the apparatus and takes power from the accumulator. It is adapted to trip the circuit breaker only when the accumulator is fully restored.

Combined Section Insulator and Double Action Quick Break Switch for Trolley Conductors.

12442.—1909. W. G. Hamilton, Twickenham. This section insulator for trolley wires has a double action quick break switch as part of the centre body insulated from either end of the body by two insulating sleeves and four insulating bushes, and on the running edge by two air gaps. The feeding point in the centre of the body is under the action of a double action quick break switch.

Producing Harmonic Variations in the Amplitude of High Frequency Alternating Currents.

12790.—1909. A. W. Sharman, Clapham, S.W. In this system of radio-telegraphy for giving musical signals an oscillatory circuit in which there are tuned oscillations of a frequency within the limits of audible sound is coupled to a circuit whic feeds a second oscillatory circuit. The second circuit in which there are high frequency oscillations is coupled to an aerial.

Metallic Filaments.

15496.—1909. Dr. R. Jahoda, Vienna. This process of manufacture of metallic filaments from difficultly fusible metals consists in adding small quantities of oxides or hydroxides of copper or silver to the paste of the metal and binding agent. During the heating process, while the usual binding agent is evaporating, the oxides bind the filaments until they are sintered together by the heat. The oxides themselves then separate from the filaments.

Electric Ignition Systems of Internal Combustion Engines.

15803.—1909. B. Brooks & F. H. Alston, Birmingham. The invention consists in the employment of two branch low tension circuits through which the current is caused to pass alternately in opposite directions at the required instant by means of an automatically operated change over device. The one circuit is broken and the other circuit completed so as to reverse the current through the induction coil of the system.

Closed Circuit Transformers.

17761—1909. Deutsche Elektro Sparlicht G.m.b.H., Frankfort. This is an improved method for manufacturing transformers with a very small output, for instance, ¼ kw, and having an efficiency of 80%. The core plates are stamped out of the yoke plates during the formation of the yoke plates and are held in position in the casing by the pressure of the yoke plates without the use of bolts or screws. By this means the magnetic resistance at the joint is reduced to a minimum.

Telegraph or Telephone Insulators.

19834—1909. H. Lavy, London, W. These insulators are constructed with a hollow cup-like head, provided with perforations through the sides. A disc corresponds to the shape of the cup and has a groove to guide the service wire. At the top of the cup-like head is a screw thread into which a cover is screwed. The cover has a boss which forces the disc down into the cup and clamps the service wire into position.

Ship Propulsion.

19872—1909. British Thomson-Houston Co., London, E.C. In this system of ship propulsion two propeller shafts are employed. On each of the shafts an electric motor is mounted, and also a low pressure low speed turbine. At cruising speeds the turbine will run idle on a vacuum or be disconnected. Two high speed high pressure turbines are located in the ship, and these both drive an electric generator. The generators are connected to conductors which supply current to electric motors on the propeller shafts. The high pressure turbines exhaust into the same condenser as the low pressure turbines for cruising speed, but exhaust into the low pressure turbines and thence to the condensers for maximum speed.

Securing Electric Incandescent Lamps.

21109—1909. C. Damey, London, W. The lamp has a plug provided with pins, which enter bayonet slots in a holder arranged within the ornamental socket of the sconce. The plug is threaded to receive a threaded ring, which is flanged and of sufficient diameter to receive a glass tube adapted to slide over the lamp to represent an ordinary candle. The flange prevents any lateral displacement of the tube. After the plug is inserted in the holder the ring is screwed against the socket so as to firmly secure the lamp.

Electric Signalling for Railways.

22866—1909. G. Carboni and C. Tironi, Florence. This is an improvement in electric signalling apparatus of the kind in which the electric generator is carried on the train, and line wires are provided composed of sections which extend over two blocks and are disposed towards the right hand side of the first block and towards the left hand of the second block, or *vice versa*, the junctions between the sections on opposite sides being arranged in staggered order, and trolley apparatus is arranged to transmit current from the generator to the line wire on one side of the track and to collect current from the line wire on the other side of the track. The invention comprises an arrangement whereby each end of the line wires extend a short distance over the adjacent block so that the trolley is always in contact with the line wire on both sides of the track. The trolley has two contact devices which contact respectively with the right and left hand line wires in the same blocks.

Distributing Box for Cables with Multiple Electrical Conductors.

23937—1909. R. Monnier, Paris. The conducting rods are coated over to a certain length with insulating material and are electrically connected to blades made integral with a screw fastened to a metallic part, and passing through an ebonite washer attached to the casing. This ensures the convenient setting of blades on the conductor rods mounted in front of the first mentioned blades. The distance between the two sets of blades is regulated by a screw and locknut.

Electro Hydraulic Press.

24784—1909. Maschinenfabrik Oerlikon, Zurich. The reservoir is fitted with an air-tight fitting float, which is pressed upon the liquid by atmospheric pressure, continuously, and according to the variations of the liquid volume in the reservoir is moved to and fro in the press cylinder. This arrangement enables the press to be used in positions in which an open reservoir would empty.

Electrically Controlling Machine Tools.

27026—1909. Felten & Guilleaume-Laymerwerke, Actien Gesellschaft, Frankfort. The invention provides a method for reversing machine tools and machines having reciprocating motion and a single drive by electric motors reversed by stops on the travelling part of the machine co-operating with a reversing switch. The field of the motor is strengthened at the beginning of the reversing period, started by the stops, and maintained in that state for a given variable period of time, whereupon the reversing of the motor takes place.

Electric Cartridge Fuses.

29087—1909. Siemens Schuckert Werke, G.m.b.H., Berlin. This cartridge is in three main parts: the cartridge proper, a cap and socket, and a metallic guard ring. The ring surrounds the greater part of the outer wall of the cartridge and is intended to prevent the bursting of the cartridge along lines parallel to its axis, which is liable to occur when the fuses are designed to be employed in heavily loaded circuits.

Telephone Switching Apparatus.

2057—1910. W. Aitken, Liverpool. This electromagnet switch for telephonic systems has a fixed coil and a spring controlled rotatable armature in combination with a pointer and connecting arm capable of being revolved over contact studs arranged in a circle, the centre of which is the centre of the pointer pivot. The pivot can be revolved until over a particular stud. It is then depressed to complete a circuit between the stud and pointer.

ELECTRIC SMELTING IN NORWAY.

The British Acting Consul at Christiania (Mr. C. F. Madeley) reports that an experimental furnace for the electric smelting of low grade iron ores into pig iron has recently been erected at Tinnfos. It is reported that a quantity of about 60 tons of this pig iron has been sent to foreign steelworks for conversion into steel, and that the quality has been found to be very good. The cost of smelting at Tinnfos is stated to be about 55 kr. (£3 1s.) per ton. Mr. Madeley adds that it is intended to erect a new and larger furnace, which will probably be at work next autumn, and which will be worked by power from the Tinnfos waterfall, where about 15,000 h.p. will be available upon completion of the necessary works. It is hoped eventually to produce some 50,000 tons of pig iron a year, which will be converted into steel by electrical process.

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NOTES.

Electricity Supply and Wages.

The Board of Trade is issuing another Yellow Book, dealing with the wages and hours of work of the people. This particular volume is concerned with "public services": those employed in the roads, sanitary and other departments of local government, and also in gas supply, electricity supply, water supply, and tramway and omnibus work, whether under municipalities or companies. The total number of people dealt with in a selected week of 1906 was 268,438, and it is significant of the struggle still proceeding that a quarter of this number were engaged in gas supply. The average earnings of all workpeople were 27s. 3d. The average earnings of men connected with electricity supply were 30s. 10d., of boys, 11s. 7d., or together 29s. 2d. The gas service, however, showed up better, the average earnings for men being 31s. 1d., for boys, 12s. 10d., or together 30s. 3d. There has been a general tendency to a rise of wages, ranging from 15 to 19%, since 1886. The average hours of a full working week were 51·9 in the electricity supply, as against 52·6 in the gas supply. It should be remembered that the average of salaried men in electricity supply is much more than in gas, which largely accounts for the discrepancy in the rate of wages.

Meters on Tramcars.

In another column will be found a brief announcement that the Electrical and Tramways Committee of the Corporation of Cardiff are asking for tenders for the supply of 130 meters to be placed on the tramcars. Mr. Ellis fully expects to effect a considerable saving by thus checking the consumption of current by each man and each car. This has certainly been the case elsewhere, especially when the adoption of the meter system is supplemented by careful training of the men. It has been found both here and in America on tramways and railways that careful driving means large savings in current consumption. Checking also often leads to early detection of faults in the apparatus. It will be found, too, that where meters are used, fewer accidents occur, simply because the men have their motors under closer control. The meter, as an instrument of precision, tends to bring about higher all-round efficiency.

Telewriting and Telegraphic Printing.

It is singularly appropriate that Sir John Gavey's "James Forrest" lecture should coincide with a remarkable rise of enterprise in connection with automatic printing of messages transmitted over the telephone or telegraph wires. Last Friday the National Telewriter Co., Ltd., opened in Walbrook, in conjunction with the General Post Office, the first public Telewriter Exchange, and the Lord Mayor, by merely taking up an electric pencil attached to a telewriter, was able to send automatically an autograph message of congratulation to the Postmaster-General at St. Martin's le Grand, who, having read the *facsimile* manuscript, sent back an answer in his own handwriting. Already the National Telewriter Co. possess a number of subscribers, and this Exchange is the result. It is probable that we shall shortly see other Exchanges in London and in the provinces. Meanwhile, Mr. Hans Knudsen is in our midst, and with the assistance of Mr. Cuthbert Hall, proposes to introduce a new system of type-printing, using either the telephone wires or submarine cables. He is using a typewriting keyboard both at the dispatching and receiving ends.

Wireless Improvements.

Improvements are proceeding apace in connection with radio-telegraphy and telephony. The Helsby wireless system, which we dealt with at some length quite recently, is now approaching the stage when it is to be made known to the public generally, and will enter the field in competition for public favour. An elaborate demonstration to the lay press at the Crystal Palace and at Chislehurst passed off triumphantly the other day. At the latter place the company's earth-induction telephonic system was put to the test, a message being transmitted about a quarter of a mile through about 100 ft. of chalk. As we said before, there is a great future for this system in surveying and exploration work, and also in mining and quarrying. Another improvement is about to reach us from Norway, where Captain Howland, of the Royal Navy, has invented an apparatus for controlling wireless messages; he systematises reception, and puts an end to confusion.

Telephones.

Everything seems to point to the fact that the National Telephone Company will not be taken over by the Post Office before December 31 of next year, as foreshadowed in the original agreement. Dividends at the rate of 6% per annum are to be paid on the Preferred and Deferred Stock of the company for the half-year just ended, as in the past year, but the amount carried to reserve is £175,000, or £25,000 more, and the carry forward is £15,000, or £3,900 better. In spite of a certain amount of criticism, it is evident that the National Co. have been pushing ahead and gaining more subscribers. Soon there will be the ticklish question to the fore as to how much the Government will have to pay for the business, and whether this will be done wholly or partly in cash, or wholly in deferred annuities. Behind these questions is the still more puzzling one as to what part municipalities are to be allowed to take in telephonic development. In Yorkshire business circles certainly the feeling seems to be in favour in municipalisation. So far, municipal telephone systems have been a success, and in big industrial centres municipalisation tends to a simultaneous lowering of rates to subscribers and increase of adherents. Local administrations need not hamper in any way the great, far-spreading national system.

Electricity on the Rand.

The report of the Victoria Falls and Transvaal Power Co., Ltd., to be presented to the shareholders on the 15th inst., and published elsewhere in this issue, is certainly an illuminating document. It shows the magnitude of the interests involved. The great contracts signed with colliery companies for the supply of coal not only illustrate one aspect of the spreading of these interests, but also the fact that the company is not, as was first intended, essentially a hydro-electric one, which very fact makes the monopolistic tendencies all the more marked. This is strengthened by the contracts for supply to the powerful mining groups. It is a huge organisation, and it remains to be seen whether the Advisory Board under the Transvaal Power Act will be able to conjure some of the dangers already looming large on the horizon of electrical development on the Rand, and, indeed, the whole of the colony.

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Public Spirited Lord Monson.

Reigate, with Redhill, is a go-ahead borough, with a population of 30,000 or more, daily growing, for it combines the characteristics of being mildly industrial and also suburban. The Corporation run a fairly successful electricity undertaking, and, naturally, like good Father Conscripts, the members of the Council are anxious to extend the sphere of operations. Certain ratepayers on a big building estate at Redhill were eager to avail themselves of the municipal electricity supply, and the Lighting Committee were equally anxious to supply the demand. But, alas! the building estate belongs to Lord Monson, a sort of minor *pater patriæ*, and the Corporation had to apply to him for permission to run the mains along the estate roads. Lord Monson graciously consented to grant a license on the conditions that:

> "The Corporation to pay to his lordship the yearly rent of 10s. for every house for the time being connected with the cable, with a minimum rent of 10s., and also to pay all costs connected with the matter, including the necessary deed of licence. It is also stipulated that the cable shall be used for the supply of electricity only to houses on his lordship's estate."

No wonder that the Town Council declared such conditions inadvisable, and so would-be consumers have to do without the convenience of electricity, and the undertaking (and with it all ratepayers) suffer in consequence. It is such extortionate terms that hamper enterprise, and that is, for instance, so largely responsible for the enormous overcapitalisation of our railways, which in turn is responsible for serious handicapping of British industries.

AIDS FOR ENGINEERS.

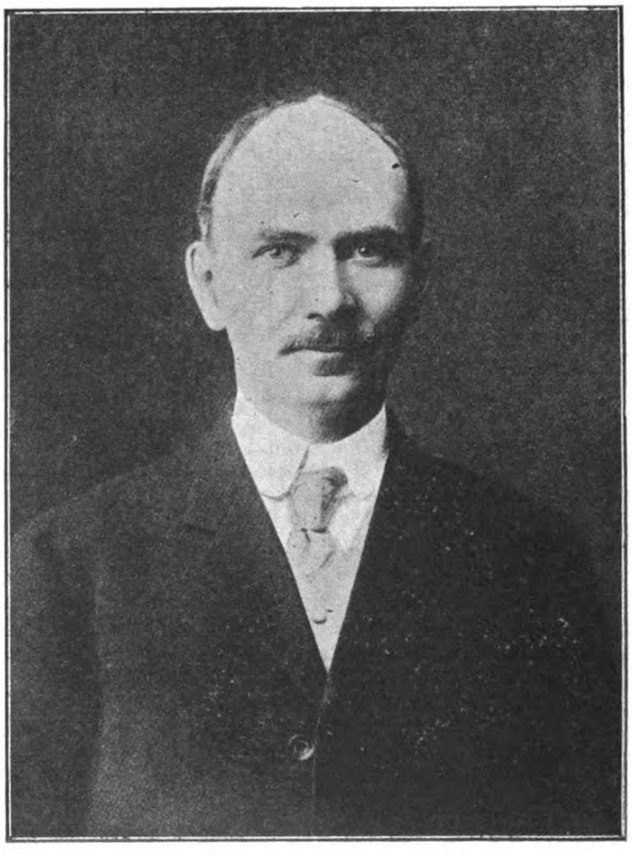
"Walker's Loose-Leaf Pocket-Book for Engineers," with tables and notes by Mr. Norman R. Corke, A.M.I.E.E. (London: John Walker & Company, Ltd., 10s. 6d. net), is one of those extremely useful things that give rise to wonder that they have not been thought of ages ago. Most professional pocket-books have become so bulky in the endeavour to meet all requirements that they are more works of reference for the office than companions to be carried for use in the workshop or on the field. Mr. Norman has, therefore, compromised. He has provided 50 pages of carefully selected, closely condensed tables and formulæ, ranging from British and Metric Equivalents to Secondary Cell Accumulators (about one-fifth of information is strictly electrical), and then given a number of loose leaves whereon the owner can make his own manuscript selections from standard works and memoranda, not only for his daily practice, but for any big job in hand. The mechanism by which the leaves are kept in place and released is perfect. It enables any number of pages to be removed and filed away in filing cases for reference, and refills of loose leaves substituted. Thus the pocket book is reduced in bulk, but made peculiarly adaptable for varied work. The leaves are of thin, tough paper, eyeleted to prevent tearing away, and are either plain, ruled or squared. The leather binding is flexible and of the strongest, with strap and catch fastening.

Messrs. Walker also publish what they call the "University Expert Manuscript Book," primarily intended for students and those carrying on experimental or research laboratory work, but really adaptable for all persons desiring to make collections of lengthy notes and drawings for filing purposes. The books consist of strong cloth bound covers, opening flat, and provided with a metal fastening to hold tear-out refills. These pages can be plain or ruled in any style desired. They are all punched with round holes, so that they can be instantly filed on the transfer cases, with ingenious but simple mechanism, provided. In this way the note books may be used for all kinds of notes, provided one page is devoted to one subject, and then the leaves can be sorted out for filing in separate transfer cases or systematic grouping. Owing to the stiffness of the covers and the peculiarity of the back binding, which enables the front cover to be turned right back, they are very convenient books for note taking, and the loose leaf and transfer cases enables temporary or permanent collections to be formed. Four standard sizes are made: 11 in. × 9¾ in., 9¼ in. × 7¼ in., 9 in. × 6 in., and 7½ in. × 5 in., ranging in price from 3s. to 1s. 6d., the refills from 1s. 3d. to 6d., and the transfer cases from 3s. to 1s.

It will be seen that Messrs. Walker are providing a series of serviceable aids for engineers.

THE A.I.E.E. PRESIDENT.

Professor Dugald Caleb Jackson, the new president of the American Institute of Electrical Engineers, is a member of a well-known Quaker family of Pennsylvania, and was born in that city in 1865. After a year or so at railway work, he graduated in commercial engineering at Pennsylvania State College, and spent two years in graduate study of electrical engineering at Cornell University. In 1887 he became associated with the organization of the Western Engineering Co. at Lincoln, Nebraska, to build electric railways and electric light and power plants. Two years later the business of the Western Engineering Co. was purchased by the Edison interests in New York, and Professor Jackson became assistant chief engineer of the Sprague Electric Railway and Motor Co. On the consolidation of all of the Edison interests, including the Sprague Electric Railway and Motor Co., into the Edison General Electric



PROFESSOR DUGALD C. JACKSON.
From the Chicago *Electrical Review*.

Co., he went to Chicago to become chief engineer of the Central District of the Edison General Electric Co. In 1891, Mr. Jackson went to the University of Wisconsin as professor of electrical engineering, and for 15 years the development there was entirely under his direction. In 1906 he was elected professor of electrical engineering, and head of the electrical engineering department at the Massachusetts Institute of Technology. In addition to his work as an instructor, Professor Jackson has served as consulting engineer on many important developments, and he is the senior member of the firm of D. C. and Wm. B. Jackson, doing a large business in the west as consulting engineers. His published works include a "Text Book of Electromagnetism and Construction of Dynamos" (1893), "Electricity and Magnetism" (1895), "Alternating Currents and Alternating Current Machinery," joint author (1896), a book on "Electricity and Magnets," joint author (1902), as well as books on central station practice.

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ELECTRICAL TERMINOLOGY.

Definitions Proposed by the American Electric Light Association.

(From Our New York Correspondent.)

Subjoined is the complete list of definitions of electrical terms just formed by the Committee of Terminology of the National Electric Light Association. The definitions are not intended to be regarded as final, and the Committee will cordially welcome any criticisms or amendments, and suggestions towards that end should be sent direct to Mr. W. H. Gardiner, 60, Wall-street, New York City.

Ampere-Hour Meter—An instrument giving the total time integral of the amperes.

Auto Balancer—An auto transformer for equalizing the load or voltage when a three, or more, wire circuit is derived from a two-wire circuit.

Auto Transformer—A transformer in which a part of the primary winding is used as the secondary winding, or conversely.

Block Rate—Method of charging for electric service at different successive rates per kw.-hour consumed, each successive rate applying only to a corresponding successive block or quantity of the total current purchased during the period covered; as an example, during each month 10 kw. hours or less at 15 cents per kw. hour. The next 10 kw. hours over the first are charged for at 12 cents per kw. hour. All current in excess of the foregoing 20 kw. hours is charged for at 10 cents per kw. hour.

Choke Coil—A reactance used in connection with lightning arresters and placed in series with the line to be protected.

Capacity Factor—Ratio of the station output in kw. hours to the maximum capacity of the station in kilowatts.

Compensated Alternator—A separately excited alternator, which automatically compensates for the drop in voltage in its armature, or in its armature or the line, by sending around its field a rectified portion of the main current, or of the current derived from a series transformer in the main circuit.

Converter—A dynamo-electric machine having one armature and one field for converting alternating current to direct current, or direct current to alternating current. The term to be preceded by the words "alternating current-direct current" (A.C.-D.C.) or "direct current" (D.C.).

Constant—(1) Of an electrical instrument is that quantity which used as a factor with indications of instruments gives results in the desired unit.

(2) Of a watt-hour meter is 3,600 × watt-hours passing through the circuit during one revolution of the meter disc.

Corrective Motor—A synchronous motor running either idle or under load, whose field charge may be varied so as to modify the power-factor of the circuit to which it is connected or through such modification to also influence the voltage of the circuit (this term is proposed instead of the term "rotating condenser").

Demand—Demand is a load specified, contracted for or used, expressed in terms of power as K.W. or P.

Demand Factor—Unless otherwise specified, demand factor shall be the maximum connected kilowatts of capacity divided into the actual kilowatts of demand, and expressed in terms of per cent.

Demand Rate—The price, or part of the price, of power charged for the demand as distinguished from the price paid for the kilowatt-hour consumption.

Discriminating Rate—A rate which does not give the same price to two or more customers, when all other conditions are equal.

Differential Rate—A rate consisting of two opposed factors; one tending to give a high rate and the other tending to give a low rate.

Dispersion Factor—The factor applied to light intensity after dispersion, which gives the intensity if the dispersion agents were removed.

Diversity Factor—Diversity factor shall be used to express the relation between the simultaneous demand of all individual customers and the sum of the maximum demand made by these customers; the sum of the maximum demand of the customers, no matter at what time they occurred, divided into the simultaneous greatest maximum demand when expressed in per cent. will give the diversity factor.

Effective Demand—The demand taken at the time of the system's greatest maximum.

Effective Load-Factor—The meaning suggested is the main load of a part of a system determined by the load at the time of the system's maximum. This value would be infinity if the service were off at the time of the system's maximum, as in the case of non-peak service. The term "effective demand" is suggested as a substitute.

Equalising Rings—Rings connected to equipotential points of multiple-wound armature to equalise the voltage between the brushes.

Feeder—An electric circuit, used to supply power to a station or service, as distinguished from circuits confined to a single station or used for other purposes than supplying power.

Flaming Arc Lamp—An arc lamp using carbon electrodes impregnated with some light-giving material.

Flat Rate—Method of charging for electric service only a fixed sum per month, or per annum, for a specified service, as supplying a certain number of outlets, for up to a certain maximum demand without reference to the quantity of electricity actually consumed.

Frequency Changer—A piece of apparatus for changing from one frequency to another, consisting of a motor driving either an ordinary alternating-current generator or a machine constructed like an induction motor. In the former case the term is to be preceded by the words "motor-generator," and in the latter case by the word "induction."

Fuse—Electric—A conductor designed to melt or fuse at a certain value of current and time, and by so doing to rupture the circuit.

Gem Lamp—An incandescent lamp using a carbon filament, which has a positive temperature co-efficient of resistance.

High Frequency—A frequency so high that Ohm's Law does not apply even approximately.

Hydro-Electric System—An electric system with generator driven by water-power.

Induction Generator—A machine similar to the induction motor, but driven as an alternating-current generator.

Induction Starter—A device used in starting induction motors, converters, etc. (when they are started by voltage control), consisting of an auto-transformer in connection with a suitable switching device.

Inductor Alternator—An alternating-current generator in whose armature windings the main magnetic flux pulsates but never reverses.

Instantaneous Peak—The highest value reached by the quantity under consideration as measured by some device which indicates the actual value of the quantity at every moment.

Insulator—Electric—A body or substance which offers such resistance to the passage of electric current that it is used to prevent the passage of current.

Intensified Arc Lamp—A term used for an arc lamp, with one of the carbons of small diameter to give a large current density per unit of arc, on wh ch the arc plays to thereby intensify the light.

Leakage Reactance—That portion of the reactance of any piece of induction apparatus which is due to stray field.

Load-Factor—The fraction expressed in per cent., obtained by dividing the average load over any given period of time by the highest average load for any one minute during the same period of time.

Load-Factor Rate—A rate based on load-factor.

Low Tension—A relative term used to designate a winding or conductor of less voltage than that with which it is related or compared.

Maximum Demand—The maximum demand may be stated in kilowatts, horse-power, 16-candle-power equivalents, or any other term specified, but preferably should be stated in terms which leave no opportunity for error, and wherever possible should be stated in kilowatts. Unless specified, it shall always mean absolutely the greatest actual maximum demand. If the greatest actual maximum demand is not intended, but it is intended to express the greatest maximum demand for a given day or a given minute, then it shall be so stated.

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Maximum Instantaneous Demand—The highest load reached as measured by indicating or recording instruments at any moment.

Maximum Simultaneous Demand—A maximum simultaneous demand shall be used to express the greatest absolute aggregate sum of certain individual demands, such as

(a) Customers,
(b) Class of customers,
(c) Classes of current,

and all rules made to define maximum demand shall apply to simultaneous maximum demand.

Momentary Peak—The highest average load carried during any 15 seconds of a specified period.

Moonlight Schedule—A schedule of buring hours for lamps which are not lighted when the moon shines.

Non-Peak Rate—See "Off-Peak Rate."

Off-Peak Rate—A rate conditioned on the non-use of service during specified hours of central station peak-load.

Operating Time-Factor—The ratio of the number of hours of operation to the number of hours in the interval considered. This can best be fixed by an example: There are 8,760 hours in the year. If a given shop operates 10 hours a day, for 300 days in a year, it may be said to have an operating factor of 34·11%.

Operating Time Load-Factor—The load-factor considered only during the time of operation. This can also best be defined by example, and would be used to express the load-factor for the running time of a shop. That is, if a shop operates 10 hours a day and 300 days in a year, the divisor would be 3,000 hours, or such other number of hours, as represented the time of running, instead of the usual divisor of 8,760 hours in the year.

Peak—The highest average load carried during one minute of any specified period.

Peak Load—The highest average load carried during one hour of any specified period. In the case of momentary peak load-factor, peak loads, the terms may be preceded by the qualifying terms "hourly," "daily," "monthly," "yearly," etc.

Power-Factor Indicator—A device to indicate the power-factor of an electric current.

Primary—That winding of an induction motor or of a transformer which directly receives power. The term is to be preceded, in the case of transformers, by the words "high voltage" or "low voltage," in the case of induction motors by "rotating" or "stationary."

Quantity Increment Rate—See "Block Rate."

Quarter-Phase—A term implying the supplying of power through two circuits. The vector angle of this voltage is 90°. This term is recommended instead of the term "two-phase."

Reactance Coil—A coil for producing difference of phase or for eliminating current.

Recording Ammeter, Recording Voltmeter, Recording Wattmeter—Instruments which make upon a chart a continuous record of the value of quantities they measure.

Regenerative Arc Lamp—A flaming inclosed arc lamp in which the products of combustion are circulating and brought rapidly in contact with the arc. The objects accomplished thereby are:

1.—To conserve the heat;
2.—To condense and deposit the solid products of combustion where they will not obstruct the light, and
3.—To exclude the oxygen and utilise rapidly the chemicals in the circulating gases.

Reverse-Current Relay—A relay used on a direct-current circuit, which operates when the current flows in the direction opposite to the normal direction.

Reverse-Power Relay—A relay which operates when the power in the circuit flows in the direction opposite to the normal direction.

Rotor—The rotating member, whether primary or secondary, of any alternating-current machine.

Secondary—That portion of an induction motor or of a transformer which receives power by induction. The term is to be preceded by the same words, as in the case of "primary."

Simultaneous Demand—The sum of the demands of a number of services occurring at the same time.

Simultaneous Demand Factor—The ratio of the simultaneous demand divided by the connected load.

Simultaneous Maximum Demand—See "Maximum Simultaneous Demand."

Static Converter—A term not recommended for a transformer.

Stator—The stationary member, whether primary or secondary, of any alternating-current machine.

Step Rate—Method of charging for electric service at definite successive rates per kilowatt-hour consumed. Each rate applying to the entire quantity purchased during the period covered. As, for example, during each month 10 kilowatt-hours or less at 15 cents per kilowatt-hour. If over 10 kilowatt-hours and less than 20 kilowatt-hours are used, all are charged for at 12 cents per kilowatt-hour. If 20 or more kilowatt-hours are registered during the month, all are charged for at 10 cents per kilowatt-hour.

Strain Insulator—An insulator used for the double purpose of taking the mechanical strain at a bend or at the end of a conductor, and also insulating the same electrically.

Synchronism Indicator—A phase indicator. A device for indicating the phase relation or the condition of synchronism between two or more periodic quantities.

Synchroscope—A synchronising device which, in addition to indicating synchronism, shows whether the machine is synchronised fast or slow.

Transformer—A stationary piece of apparatus for transforming, by electro-magnetic induction, power from one circuit to another, or for changing, through such transformation, the values of the electromotive force.

Turbo-Generator—A steam turbine coupled to an electrical generator.

Voltage Regulator—A device for regulating or varying the voltage of a circuit. When it consists of a transformer (whose primary is in shunt to a circuit and whose secondary is in series with the circuit), whose ratio may be varied, the term is to be preceded by the term "induction" or "contact," according as the voltage is varied by changing the amount of magnetic flux between the primary and the secondary, or by changing the number of turns in the secondary in series with the circuit.

Voltmeter Compensator—A device used in connection with a voltmeter to make it read low by the amount of the line drop, and thus cause it to indicate the voltage delivered at the end of the line or at any other predetermined point of the line.

Watt-Hour Meter—An instrument giving the total time integral of the watts.

Wattless Component Indicator—A device for measuring the product of voltage of a circuit, and the component of current at 90° with the voltage. This product is the heating effect in excess of the heating that would be given by a circuit of the same voltage and power at 100% power-factor. The device is a wattmeter with coils connected to measure volts times current at 90° from the voltage phase.

ACTON'S ELECTRICITY SUPPLY.

The Acton Urban District Council have taken further action with regard to the local electricity supply. By 11 votes to 6 (7 abstaining from voting) the Council at its last meeting decided to serve notice on the Metropolitan Electric Supply Company, Ltd., to terminate at the end of 1913 the agreement by which the company supplies electricity in bulk to the Council. Councillor Shillaker moved that the resolution carried at the previous meeting, proposing to hand over the electricity undertaking to the company be rescinded on the following grounds, that—

1. The company was unwilling to agree to a limitation of the maximum charge to the Council.

2. That the Council was bound to use electricity in the streets.

3. That the company would not give anything for the goodwill of the business which the Council had built up.

He declared that by utilising the waste steam from the dust destructor the Council could generate 15% more electricity than was now taken from the company, and with the small capital charges involved (£5,000) the Council could make the concern pay. The motion, however, was defeated by 14 votes to 6.

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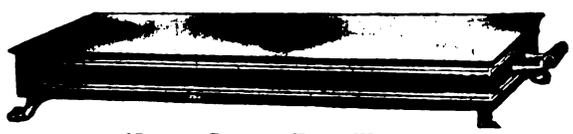
Electricity in Summer-Time.

IV. Article.—Domestic Appliances.

The immense variety of domestic apparatus to which electricity can be successfully and economically applied is admirably elucidated in the catalogues of the leading manufacturers. We have already dealt in detail with electrical cooking appliances from stoves to egg-boilers, and some others still remain to be described. But of the smaller appliances there may be enumerated bed-warmers, hair-dryers, curling-iron heaters, cigar and cigarette lighters, hat irons, billiard table irons, brazing pans, glue-pot heaters, sealing-wax heaters, bronchitis kettles, crimping iron heaters, glossing irons, tailors and laundry irons, shaving pots and soldering irons, and even this list, varied as it is, is by no means complete.

MESSRS. SIEMENS BROTHERS DYNAMO WORKS, LTD., Caxton House, Westminster, and (Showrooms) 39, Upper Thames-street, E.C.

For those who do not mind going to a little extra expense, an electric oven manufactured by Messrs. Siemens may be confidently recommended. This oven is constructed in cast iron, thoroughly well enamelled within, finished externally with enamel and bright facings and suitably packed with non-conducting material. It is fitted with gate-hangers, grid-shelves, browning-pan, drip-tin and meat-hook, and is made in two sizes—one measuring externally 28 in. by 18¾ in., with a depth of 15 in.; and the other 31 in. by 17½ in., with a depth of 21¾ in. The former is arranged for 1,500 to 1,875 watts and listed at £12 17s. 6d., and the latter for 2,000 to 2,500 watts and listed at £15 10s. Both are fitted with switches to secure any desired heat up to the maximum. Another excellent piece of apparatus is a combined cooking range and grill, without oven, which for 1,000 to 1,250 watts is listed at £4, and for 1,500 to 1,875 watts at 10s. more. This is an especially handy appliance, since it only measures 9 in. in length by 9 wide, and 6½ in. in height, and weighs only just over 24 lbs. The illustration here given shows a food warmer which is made



NICKEL PLATED FOOD WARMER.

in various sizes, from 16 in. by 10 in., listed at 50s., to 36 in. by 24 in., listed at 187s. 6d., all finished in nickel plate or polished copper as desired. Plate warmers are listed at 25s. to 57s. 6d., and hot plates at 15s. 6d. to 50s. 6d., according to size. Electric kettles range from 10s. 6d. to 87s. 6d., according to size and finish.

The coffee machine here illustrated is made in nickel,

COFFEE MACHINE.

takes 300 watts for a capacity of 1½ pints, and is listed at 37s. 6d. A shaving jug, taking 180 watts, finished in copper, is priced at 30s., an egg-boiler at 24s. 6d., and a milk heater at 32s. 6d. Hot-water jugs are supplied in various capacities from two pints upwards, and in numerous designs in nickel and brass. The jug illustrated is hand-

HOT-WATER JUG.

somely finished in antique brass, takes only 80 watts, and is listed at 30s. Saucepans range from 20s. upwards to one with a capacity of 12 pints at 40s., and porringers and frying pans are also stocked. Messrs. Siemens Brothers have also a variety of domestic irons ranging in price from 15s., with a weight of 4 lbs., to one of 18 lbs. at 45s. We give an illustration of a billiard table iron weighing 17½ lbs.,

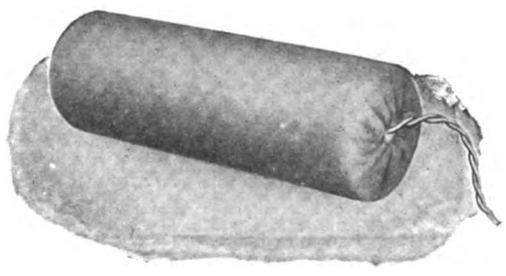
NICKEL BILLIARD IRON.

taking 400 watts and listed at 47s. 6d. Stands for any of these irons are supplied at 2s. 6d. each. Of miscellaneous articles we give an illustration of a cigar lighter which is

CIGAR LIGHTER.

listed at the low price of 9s. 9d.; a 10-inch bed warmer is priced at 17s. 6d., a hair-dryer at 27s. 6d., and curling-iron heater at 19s. 6d.

Among the specialities coming under this general head may be mentioned a nickel-plated 3 lb. iron manufactured by the BRITISH PROMETHEUS COMPANY (Salop-street Works, Birmingham, and 9, Newman-street, Oxford-street,



BED WARMER.

London), which is fitted with a three-plug arrangement on the "universal voltage" system, which enables it to be used on any voltage between 100 and 250. It is listed at

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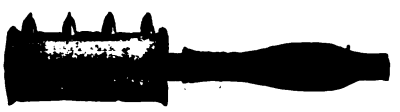
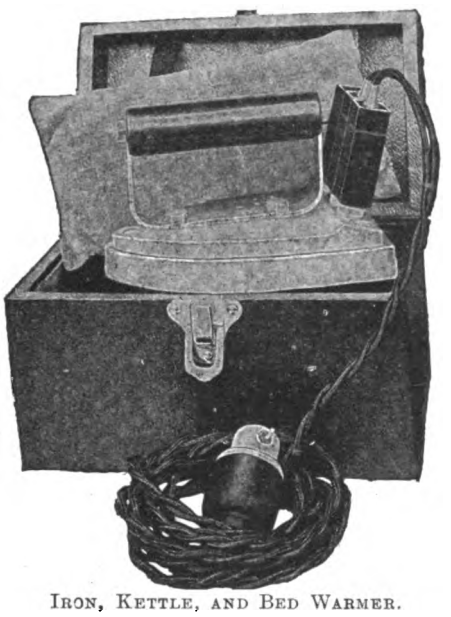
25s., or can be had complete in case, together with an electric hat pad, for 32s. 6d. The same company also list a universal voltage bottle at 24s. 6d., taking for the 1½ pint size 400 watts, and a bedwarmer at 25s. 6d.

The Prometheus domestic irons range from one of 3 lbs., listed at 10s. (illustrated herewith) to one of 12½ lbs. at 32s. 6d., all heavily nickel-plated, and taking from 150 watts for the lightest, to 520 watts for the heaviest. The



HAIR-DRYER.

iron illustrated (No. 278) has been especially designed to meet the demand for a cheap, serviceable and thoroughly reliable iron, and is made in two weights, 3 lbs. and 5 lbs., listed at 10s., and 12s. 6d. respectively. Laundry irons range up to 18 lbs. in weight, listed at 45s.



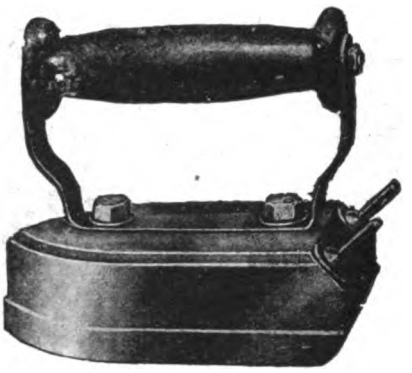
IRON, KETTLE, AND BED WARMER.

The Prometheus bedwarmers are made in the old-fashioned warming-pan pattern, at 32s. 6d.; in the foot-warmer pattern at 35s., and in the cylindrical form at 17s. 6d. The last-named takes only 15 watts of current. The same company supplies a nickel-plated hair-dryer at 27s. 6d., a curling-tongs heater with automatic switches at 19s. 6d., and cigar lighters from 9s. 9d. Sealing-wax heaters range from 24s. upwards; copper glue-pots from 27s. 6d. to 60s., and soldering irons from 35s. to 77s. 6d.

Among the specialities of the GENERAL ELECTRIC COMPANY (71, Queen Victoria-street, London, E.C.) there is a very effective bedwarmer listed at 21s., which only consumes 30 watts per hour; a heating pad (to take the place of poultices or hot water bottles) at 30s., taking 50 watts, and a hat pad at 27s. 6d., which appears to be a very attractive line. The General Electric Company also stock

ROMAN LAMP.

cigar lighters in hammered copper, oxidised silver and polished brass, ranging in price from 12s. to 18s., as well as the Swinton-Angold lighter, which transforms current down to low voltage and uses a solid platinum strip for ignition which can be used equally well for cigars, cigarettes or pipes. As it is fitted with a transformer, it can, of course, only be used on alternating current. Prices are 33s. 9d. up to 110 volts, and 39s. 6d. for 200 to 220 volts. Curling-irons of artistic finish and ornamental appearance range in price from 12s. 6d. to 32s. 6d., and a heater for crimping-irons is listed at 40s. The domestic irons of the General Electric Company vary in weight from 4 lbs. to 10 lbs., and in price from 12s. 6d. to 27s. 6d. Laundry irons range from 21s. to 27s. 6d., and tailoring irons run from 10 lbs.



NICKEL-PLATED IRON.

at 32s. to 25 lbs. at 46s. The General Electric Company billiard table iron, weighing 22 lbs., has a foreground absolutely true, with edges rounded off, and is listed at 50s.; sealing-wax heaters run from 28s. 6d. to 35s., glue-pots from 31s. to 57s. 6d., and soldering irons at 22s. 6d. and 37s. 6d.

THE ADAMS WATKIN CO., LTD., 36, Victoria-street, Westminster, S.W.

Although the patent Watkin switch electric current controller has a general application wherever electricity is used—being a great boon in connection with lighting, as it permits of perfect regulation with saving of current—it is specially mentioned here as a means of facilitating the economical employment of electric current for all kinds of domestic apparatus. As will be seen from our illustration the switch controller is compact, ornamental and perfectly safe, being completely enclosed. With the standard controller seven variations of energy are possible, though a switch can be specially constructed with even finer gradations. This is done in such a way that not only

WATKIN'S CURRENT CONTROLLER.

is the energy used adapted to the needs of the moment, but the current is at the same time saved. In an elaborate series of experiments carried out by the Electrical Standardising and Testing Institution, Faraday House, it was found that when testing 210 volt carbon lamps on direct circuit, from 12½ to 80% of current was saved according to the degree of illumination required. The controller was even more effective with the alternating current. As regards safety, it was found that the insulation resisted 1,000 volts. It should be understood that this controller switch can actually be applied to the metallic filament lamp, so that with these we can now have at will either the wonderful brilliance or the softness of low voltage carbons, and saving current all the time. As we have said, it can be generally applied. For instance, it can be used to regulate any kind of fan, desk, bracket, ceiling, or the large port-hole exhaust and blast air propellors, the regulation being

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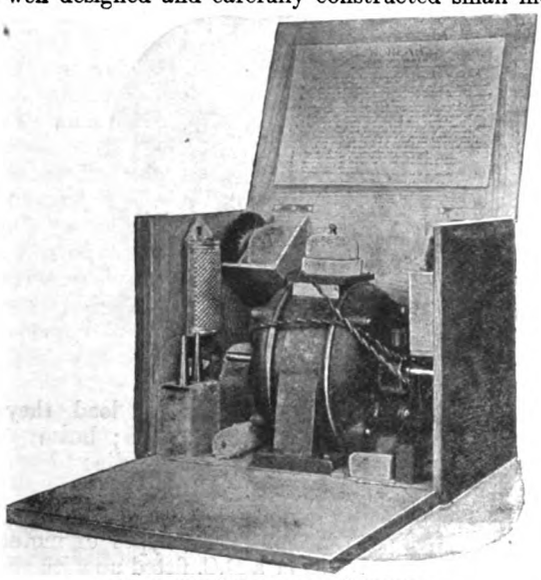
as flexible and effective no matter what the distance from the fan to the controller. Applied to cookers and heaters it gives a fine and practically instant adjustment of current and consequently of heat. This makes it invaluable for such very diverse objects as the control of a single iron for ironing heavy or the flimsiest of materials, the running of a domestic or other motor, or the accurate regulation of current supplied to surgical and medical apparatus. The applicability of the controller switches to the ordinary household as well as to big establishments will be seen when we mention that a 70 watts controller, with 3 variations, for carbon filament lamps and fans can be bought for 17s. 6d.; a fine speed switch of 130 watts for carbon and metallic filament lamps from 100 to 250 volts and for fans, at 19s. 6d.; a seven variation controller of any voltage from 70 to 200, applicable to lamps, fans, motors, etc., for 21s.; a seven variation controller of any voltage from 200 to 440, for lamps, radiators, cookers, fans, motors, etc., for 30s.; and a seven variation switch of any voltage from 450 to 600 for all kinds of work, for 35s. Undoubtedly the Watkin controller switch will prove one of the most efficient means of popularising the use of electricity, for it brings with it safe, easy regulation, and a quite remarkable economy.

THE "BOREAS" PNEUMATIC SWEEPER CO., 91, Victoria-street, Westminster, S.W.

The "Home Polisher" introduced by this firm consists of a well designed and carefully constructed small motor,



ELECTRIC SERVANT IN CABINET.

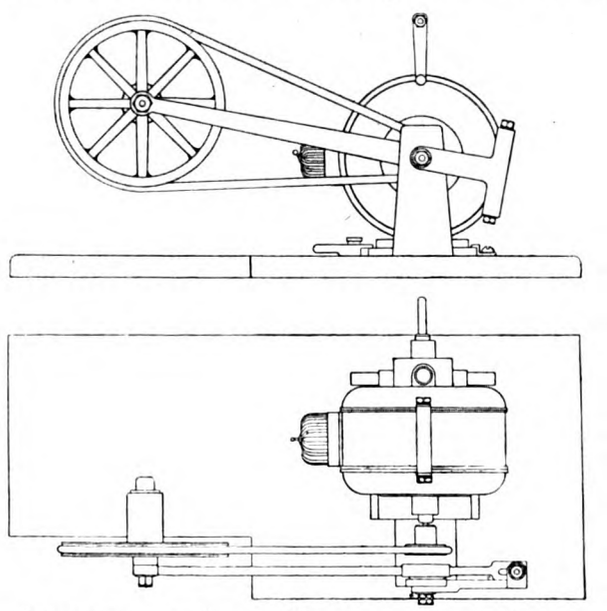
fitted with ordinary tumbler switch on the top of the case, plugs for motor and lamp sockets with 12 ft. of flexible cord. On either side of the motor are adjustable spindles

ELECTRIC SERVANT ON STAND.

to which can be fitted a variety of circular appliances, such as bristle brushes, woollen and swansdown mops buffs, bootcleaning equipment, knife and metal polishers, grinders, or pulleys for driving small pumps, lathes, sewing or other machines. The motor can be fixed on a table on its own base, or on a tall tripod stand. It is self lubricating and consumes about ½d. of current per hour. It can be run with the greatest of ease by anyone possessing a modicum of intelligence, and will do an immense amount of work, in an incredibly short space of time, thus making it equally suitable for use in the circumscribed modern flat or in a large establishment, and both for serious household work and for hobby occupation at the lathe with wood or metal work. The standard equipment fitting into a cabinet costs £7 17s. 6d., though extra charges are made for tripod stand and additional appliances for the spindles.

R. BORLASE MATTHEWS' PATENTS, Bank-buildings, Kingsway, London, W.C.

An objection to the electrical driving of hotel and ordinary household machinery which is used but a few hours a day, or even but one or two days per week, is the prime cost of the separate motors and of the speed reduction gearing required. This objection has, however, been ingeniously and successfully overcome by the introduction of a combined arrangement of a motor and friction driving gearing, facetiously called the "Electric Mary Ann," which is the invention of Mr. R. Borlase Matthews, Wh. Ex., A.M.I.C.E. This device is so designed that it will drive any standard household machine that has an existing wheel or pulley by simply allowing the friction wheel to press on the latter. It will also drive any domestic appliance that has a crank handle, by removing this crank handle and in its place attaching one of the adaptors supplied with the apparatus. The motor is equipped with a swinging arm, one end of which is mounted concentrically with the axis of the motor, and the other end carries a grooved wheel about 7 in. in diameter driven from the motor spindle through a leather belt. At one side of this grooved wheel, and attached to it, is a small pulley covered with rubber. This small pulley



ELEVATION AND PLAN OF MOTOR AND DRIVING GEAR.

is placed in contact with the rim of the wheel of the machine to be driven, and this transmits the motion from the motor. This pulley is kept in contact with the rim of the wheel by aid of helical springs pressing against the end of the radial arm at the motor. The motor is provided with a large and convenient handle so as to facilitate carrying the machine about, while the starting switch is fixed to a projecting boss on the frame of the motor, a flexible cord with a suitable lamp socket connector is wired on to the switch. The motor employed is of 1/7 h.p., liberally rated, so that it can carry considerable overloads for short periods, and is totally enclosed. Ball bearings are employed so as to obviate as far as possible the necessity for frequent lubrication. Its speed is about 1,900 revolutions per minute, while that of the machines to be driven is about 60. At normal loads the consumption is about 70 watts, but when running heavy machines, such as vacuum cleaners, the consumption rises to about 130 watts. The rectangular base of the motor is attached to a wooden baseboard by means of a double

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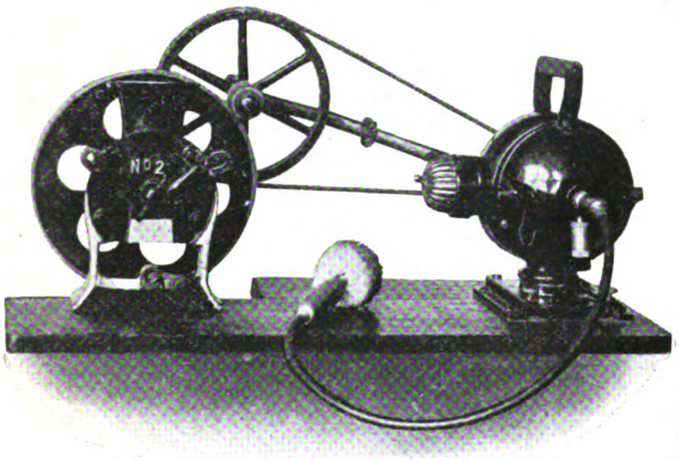
angle iron and an adjustable cam. A turn of this cam, one way or another, instantly releases or as quickly fixes the motor to the baseboard. In order to adapt domestic hand-driven appliances for electric driving, special metal bosses are provided to fit over the existing spindles in place of the crank handle normally employed. The external dimensions of these bosses are made to a standard gauge, so that a cast iron wheel, also supplied with every outfit, can be slipped over any of these bosses. The bosses, when attached, are never removed from the various appliances. Domestic appliances are usually provided with some form of clamping screw for attaching them to the table. As it is some trouble to do up and undo these screws, it is preferable to attach each machine permanently to a small piece of wood about 4 in. wide by 14 in. long, which fits into automatic spring clamps attached to the baseboard of the "Electric Mary Ann"; several of these boards are supplied with the apparatus. Thus to drive any machine that is so fixed, all that has to be done is to place it on the board with sufficient pressure to snap open the spring clamps, when it is held firmly in position for driving. For boot polishing or silver and plate cleaning, a flexible shaft is employed, connected direct to the motor spindle by means of a special attachment. The free end of the shaft is provided with a swivel handle, and is screwed to take brushes, buffs or mops, a number of which are supplied with the equipment for cleaning boots, or polishing silver or plated articles. This

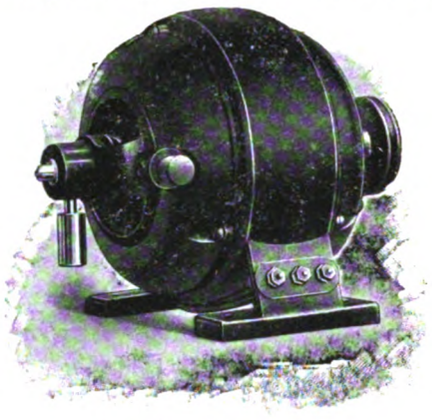


method of polishing by aid of a flexible shaft produces far better results than when the polishing bobs are mounted direct on the motor spindle. From the above description it will be appreciated that the attachment and detachment of the various household appliances only takes a few seconds, and by electric power what is generally regarded as an arduous, protracted task is achieved with ease and no physical effort in a minimum space of time. The motor will drive any machine that is ordinarily turned by hand, and the list of such appliances is well over 50. Even if the appliances are carelessly attached to the machine, so that they are out of alignment, experiment has shown that it will still be driven satisfactorily.

The "Electric Mary Ann" will drive the following domestic appliances:—Air compressors, boot cleaners, brasswork polishers, bread graters, buffers, cake mixers, carpet cleaners, cheese and other graters, churns, coffee grinders and roasters, cream separators, dish washers, dough mixers, drills, dumb waiters, egg whisks, emery wheels, fans, grate cleaners, grinders, hair brushes, ice-making machines, ironing machines, knife cleaners and grinders, knitting machines, laundry machines and mangles, meat choppers and mincers, polishers, potato peelers, raisin stoners, rotary pumps, sausage machines, sewing machines, vacuum carpet cleaners. In fact, the "Electric Mary Ann" is capable of working any domestic appliance which has hitherto been turned by hand.

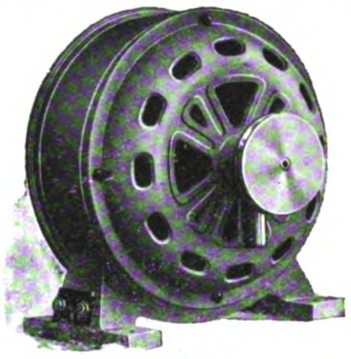
HOGAN & WARDROP, Gloucester-mansions, Charing Cross-road, London, W.C.

As mentioned in our previous notice, this firm make a study of producing well-made, moderate-priced small power motors, ranging from one-sixtieth to one-eighth of a horse-power. They are made in three types, "E" for direct current, "M" for alternating current, single-phase, and "I" for alternating current, three-phase. The D.C. motors are



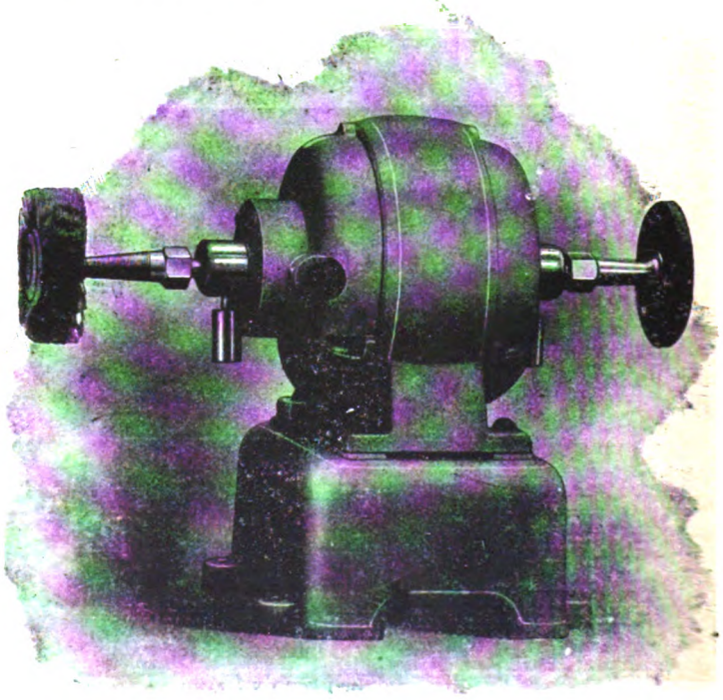
D.C. MOTOR.

made in four sizes, one-eighth, one-sixteenth, and one-thirtieth horse-power, both series and shunt wound, and one-sixtieth horse-power series wound. The A.C. motors are made only in the first three of the above-named sizes, are of the induction type, and self-starting, thus requiring no extra starting switch. It should be noted that single-



A.C. MOTOR.

phase motors will not start against full load, they have therefore, to be run free for a short space; but at a small extra expense a special pulley can be supplied to overcome this waste of time and energy. All motors are well made and have interchangeable parts, so that spare parts can be supplied to remedy defects. Both types of motors are illustrated, and we also show a D.C. fitted up with grinding and polishing attachment.



D.C. MOTOR WITH GRINDING AND POLISHING ATTACHMENTS.

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DEVELOPMENTS IN TELEGRAPHY AND TELEPHONY.

By Sir John Gavey, C.B., M.Inst.C.E.

(*Continued from page* 8).

Writing telegraphs, based on the fact that two ordinates at right angles to one another can be made to describe any curve, have been designed. The telewriter, in which the pen is connected to two arms which follow the movements of the writer, and which in doing so pass over varying resistances and transmit to line currents of varying strength, is well known. At the receiving end two pivoted electromagnets, placed in a very powerful magnetic field, are deflected over arcs dependent on the strength of the current circulating at any moment. Two arms at right angles to one another are connected to the transcribing pen, one arm being pivoted to each magnet and the writer's movements are reproduced.

In the beautiful writing apparatus designed by Pollak & Virag a slip is perforated by suitable means with nine rows of holes of varying sizes, suitable flexible brushes make contact through these holes between batteries and the line wires, and thus cause currents of different electromotive forces and duration to circulate over the line, and to act on two telephone receivers at right angles to one another. Rays of light are reflected from one to the other and on to a photographic slip, and the written messages, which can be transmitted at 600 to 1,000 words a minute, appear developed and fixed on the sensitized paper which emerges from the dark closet of the apparatus.

So far we have only considered the apparatus for the transmission and receipt of telegrams on land lines, but before we proceed with our subject it is necessary to deal with the behaviour of the conductors by means of which electrical energy is transmitted from one station to another. In considering this branch of our subject, there are several factors to take into account, each of which may profoundly modify the results according to the circumstances under which the transmission takes place. These factors are conductor-resistance, electrostatic capacity, self-induction and insulator-resistance or its reciprocal leakance.

Resistance wastes the effective electrical energy by degrading it into heat, and its sole effect is to reduce the amount of current available at the distant end. Electrostatic capacity converts a portion of the kinetic energy into potential energy, which is restored to the circuit on the cessation of the current, and it has the effect of retarding the receipt of the first portion of each signal and extending its duration when the line is disconnected from the source of energy. To illustrate, assume the case of a conductor with high capacity, say a length of submarine cable. If the far end is disconnected then on making contact with one pole of a battery, the other pole of which is to earth, there is a rush of current into the cable which continues until the latter is charged to the potential of the battery. When the battery is disconnected from the line and replaced by the earth, the charge leaks out in the form of a reverse current. If, when the battery contact is made, the far end of the line is to earth the initial portion of the current is taken up in establishing the cable charge, whilst only a fraction of its ultimate value trickles out at the distant end a short interval after the battery contact is made. The duration of this interval depends on the capacity and resistance of the line. When the full charge has accumulated along the circuit, the full current dependent on the potential and the resistance flows along the conductor. On replacing the battery by earth the charge flows out at both extremities, the diagram illustrating the distribution of potential which exists for a brief period, and which illustrates the flow of the current in opposite directions until discharge is complete.

Self-induction may be taken as the analogue of mechanical inertia. The first effect when a source of electrical energy is connected to a conductor is to establish a magnetic field in planes at right angles to the conductor, and this retards the period when the full strength of the current is established. Conversely, on the cessation of the primary current the magnetic field closes in on the conductor and generates a transient current in a direction which tends to prolong the original current.

Leakance causes a loss of current that should otherwise be utilised in actuating he distant apparatus. Per contra, it exercises a beneficial effect in high capacity lines in facilitating the static discharge, but so far it has not been found practicable to utilise the effect without introducing other evils. These somewhat elementary facts, which of course are well understood, have been referred to so as to maintain the logical sequence of our subject, for they govern the limiting distances and speeds at which electrical communication of all types can be maintained, and they account for the very different results obtained on overhead, underground and submarine circuits respectively.

Overhead wires, for many years almost exclusively used for telegraphy, and even now the only conductors that serve satisfactorily for really long-distance telephony, possess the advantages of low resistance which can be diminished to any reasonable degree by the use of copper, and by increasing the size of the conductor, their electrostatic capacity is small, say from 0·013 to 0·014 microfarad per mile, and their self-induction is relatively great. Their use admits of attaining the maximum speed in telegraphy; and perhaps the most important limiting factor in this case is the self-induction of the receiving apparatus, which would be a useful factor if distributed over the line, but which tends to act as a choking coil when massed at the extremity. This self-induction in the case of the Wheatstone receiver amounts to as much as one henry, and its effect in prolonging the current, combined with that due to the capacity of the line, is neutralised to some extent by inserting a shunted condenser between the instrument and the earth.

Overhead telegraphs are subject to serious interruptions, due to the falling of trees during heavy storms, and to breakdowns arising from a combination of sleety snow and gales of wind against which no engineering precautions are of any avail. On the other hand, until recently, underground wires, owing to their capacity, which reached 0·3 microfarad per mile when insulated with gutta percha, and the great cost of the material, where only used in special cases where strategical or other imperative reasons rendered such a course necessary. The introduction of dry paper as an insulating material profoundly modified the situation. The electrostatic capacity of suitable paper is not very much greater than that of air, and wires apped with paper, cabled, thoroughly dried and enclosed in a lead sheath are not only available for long underground telegraphs, but it is not too much to say that without them the modern development of the telephone would have been wholly impossible. The Post Office has within the last few years laid 138,000 miles of paper insulated wire underground for telegraph purposes alone, and to illustrate the bearing of this material on telephone progress it may be added that, between 1900 and 1902, before a single subscriber had been served, the Post Office laid 240,000 miles of wire underground as the first step in the development of the London system, and from its central exchange in Carter-lane 210 ducts radiated to various portions of the centre to be served from that point, and although at that period 36,000 wires only were led into the building, the spare duct capacity admitted, as the system grew, of increasing this number to 125,000 or 150,000 wires. The mileage of underground wire laid by the Post Office in Great Britain for telephones is now increased to 521,000 miles. By no other known means could such a service have been provided, and these facts emphasise the connection between paper insulation and telephone development.

Submarine telegraphy is not susceptible of the many developments that have been possible with land-lines. The high electrostatic capacity, varying from 0·3 to 0·4 microfarad per mile, and the very long lengths that are necessary to connect the great continents of the world, rendering the use of any but the most delicate apparatus impossible on long cables. The receiving instruments originally invented by the late Lord Kelvin, then Sir William Thompson, are still the only apparatus available for the reception of messages on long transcontinental cables, and so far it has not been found possible to materially increase the speed of working except, of course, by increasing the dimensions and cost proportionately.

Attention has been devoted to eliminating disturbing elements and perfecting the signals by the use of automatic transmission and by the use of curbing devices at the

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receiving end. The introduction of repeaters at intermediate points where cables land at suitable localities has recently become possible, and it may be that methods of distributed induction referred to later may ultimately be of some value, but this subject is not ripe for consideration. Short cables present no difficulties that cannot be overcome for relatively rapid working, but their electrostatic capacity limits materially the distance over which telephone working is possible.

In ordinary telegraphy when transmitting through an overhead line the frequency of the current alternations is only 180 per second for 450 words per minute, and the current has actuated the apparatus at the further end before the battery connection has ceased. Another condition, however, is introduced when a conductor is used for telephonic speech in which a maximum frequency of 1,800 to 2,000 vibrations per second has to be dealt with. In these cases the transmission from the telephone assumes complex wave-forms, and the effect of even a moderate capacity becomes far more marked than in the case of telegraphic transmission. If a simple wave impulse were emitted in a circuit containing neither capacity nor inductance it would maintain its form, and it would only lose in amplitude owing to the waste of energy in heating the conductor. With much capacity in the circuit, however, the wave tends to elongate; and if the capacity be sufficiently great and the line sufficiently long, the following wave overtakes the lagging tail of the previous one, they blend more or less together, and having lost their distinctive character they fail to impress on the receiving telephone the distinct character of the sound from which they emanate. Of course, if this happens with a simple sine wave, it will be obvious how much this damping action is intensified in the complicated wave-forms which speech assumes.

Of course, the loss of the overtones means diminution of the timbre of the voice; in other words, though speech may still be possible but the voice ultimately becomes less recognisable until when a certain limit is passed if the resistance of the conductor be not too great it may degenerate into a low-toned imitation of speech, or with the smaller conductors which are used for city work the attenuation rapidly lowers the volume of sound until it becomes unrecognisable. A few years ago I had, in conjunction with the Engineer-in-Chief of the National Co., Mr. Gill, to fix certain standards of speech which had to be maintained by the two administrations working the telephone system in this country, and after a series of practical tests, which were found to accord most closely with theoretical calculations we found the results shown on the screen to represent the practical limits of ordinary commercial speech on various classes of conductor, both overhead and underground, when no special steps were taken by artificial means to overcome the deleterious effects of capacity. I have, however, referred to self-induction as the analogue of inertia in mechanics, and obviously, therefore, if it were possible to endow the circuit in which a wave was in movement with sufficient self-induction to prevent the tailing and consequent distortion of its form, the limit of speech would be materially increased, as the attenuation due to resistance alone would have to be provided for. Now it is possible to achieve this result to a certain extent by adding artificially to the self-induction of telephone cables, technically termed loading. The ideal method would be to increase the self-induction uniformly throughout, and attempts have been made to effect this by lapping a copper conductor with thin iron wire or tape of a high magnetic permeability. Another method consists in distributing magnetic coils at uniform distances of a mile or two apart throughout the length of the line. Under these conditions the distance over which speech is possible has been increased from two-and-a-half to three-and-a-half times.

The British Post Office has recently laid a cable with distributed inductance between England and France which will increase the range of speech about four times as compared with a similar type of unloaded cable.

The rapid and enormous development of the telephone service that has taken place throughout the world within the last few years is a remarkable achievement of the electrical engineer. The principle of the microphone which converts sound vibrations into the electrical vibrations, and of the telephone which reconverts the electrical into sound vibrations, are so well known that I need not dwell further on the subject than to point out that Graham Bell's telephone, as it left his hands in 1876, is essentially the same instrument, slightly improved in mechanical construction, as he gave it to the world, but all the other adjuncts of a complete telephone service have been profoundly modified and we are not yet in sight of finality.

The problem of connecting two subscribers' lines at an exchange is a very simple one when a small number of subscribers only are concerned. An electrical indicator of the shutter type to announce a call, flexible conductors to connect any two lines by means of plugs and spring jacks, electrical bells to call up subscribers, and the equipment is complete. The problem is a serious one, however, when, as is now the case, the number of telephone subscribers in a large city runs into five or frequently six figures, when the area covered, like that in London, amounts to 640 square miles, when it has to be served by 60 to 100 separate exchanges, between all of which intercommunication must be provided with the minimum amount of delay, and when an exacting public expects to get through to any subscriber on a large system immediately the call is made or sooner. Add to this the interurban communications between all the principal cities in the country, and the fact that practically the major part of the business of the 24 hours is concentrated in about 2½ hours in the morning and a similar period in the afternoon, and the difficulties to be solved become faintly apparent, even to the uninitiated.

Apart from minor improvements in the calling indicators and other details, each of which added its quota to the gradual perfection of the service, perhaps the most marked advance that was made, when exchanges grew in size, was the introduction of the so-called multiple switch. Before its introduction, each operator had the care of, say, 100 subscribers whose lines terminated in front of her. She could connect any two of these 100 directly, but as soon as a connection had to be made to another position a subsidiary junction line had to be brought into use and the services of another operator invoked to complete the connections, and as the number of subscribers on the exchange increased the number of junction lines interconnecting the whole of the positions increased in a geometrical ratio. This became a very serious element in cost, and the complications and consequent delay in completing the connections between subscribers on various positions gradually increased in a much greater proportion than the number of subscribers. To obviate this difficulty the so-called multiple switch was designed, and it provided that any operator responsible for answering the calls of, say, 100 subscribers could connect any one of these direct to any other subscriber on the same exchange, even if the number reached 10,000 or upwards. To make this clear it is advisable to repeat that a subscriber's line terminates on a small compound spring called a jack and if a flexible metallic cord terminating in two plugs is provided on the insertion of one of the plugs into one subscriber's jack and the other in a second jack both of the subscribers find themselves in direct communication with one another. In the multiple board the lines of, say, 100 subscribers are terminated as before stated on one operator's position; but on a large panel above these local jacks the whole of the 10,000 or more lines are connected to a series of jacks within reach of the operator, and this is repeated at every operator's position, so that a line on any position can be directly connected with any of the other lines on the exchange by the operator who answers the call. This improvement, great as it was, did not meet all the difficulties. The shutters of the indicators had at first to be restored by hand after a call had been answered, every such operation causing some slight delay, which, multiplied by thousands of operations, eat into much time. An arrangement was, therefore, designed so that the insertion of a plug into a jack, the first operation in answering a call, caused the shutter to be restored to its normal position automatically. This, however, left untouched another source of delay, that necessary to connect mentally the particular shutter that had fallen with its corresponding jack before inserting the answering plug, which, if not correctly done, resulted in the plug being inserted in the wrong jack.

(*To be continued.*)

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TRAFFIC AND ELECTRICITY.

The United States Census Bureau have just issued an elaborate report on "Street Railway Development," based on the statistics of 1907. It is a pity that the figures could not be brought more up to date, for the progress made within the last three years is even more startling than that achieved in the preceding like period. However, even as the report now stands, we find that in 1907 electricity furnished 99% of the motive power, an increase of 55·2% as compared with 1902. This increase was not all due to laying down of new lines, but also to a considerable extent as the result of electricity ousting horse and other forms of power. Before going any further, it is important to note a significant difficulty met with by the Census Bureau, and how it was overcome. It was found that owing to the street railways (practically answering to our tramways) extending into the country, with the inter-urban railways spreading about and adopting electricity, the two classes in a sense became merged, and both street railways and inter-urban railways are included in the general return. The same phenomena is manifesting itself with us by means of light railways in certain provincial towns, and the running of automobile trains and cars on main lines for suburban traffic, and, again, by means of those links in the metropolis—the tube railways. The report before us shows that the number of companies in America was 1,236 in 1907, an increase of 25·2% over 1902. It is doubtful whether this relative percentage increase has been kept up within the past few years, not because there has not been keen development, but because the mergers will probably be found to have counterbalanced the new ventures. That is to say, the urban and inter-urban means of traffic are more and more being concentrated in the hands of powerful controlling financial groups. In this we find a difference as compared with what is taking place over here, for

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putting aside the whole network of metropolitan underground railways, we see a lessening of company tramways and a growth of municipal enterprise. And with us, again apart from the metropolitan underground railways, it is chiefly the municipalities who have been responsible for electrification of old lines. Returning to the overseas statistics, we find that the total number of miles of line was 25,547 in 1907, an increase of 53·5% over 1902. The total mileage of track, including double lines and sidings, was 34,403, proving that there was a considerable amount of single track lines. It is interesting to add that 136·11 miles of track were operated in 1907 by horse (a decrease of 47·5 since 1902), 61·71 miles by cable (decrease of 74·4%), and 146·05 miles by steam (a decrease of 13·9%). Another very notable branch of the subject relates to cost of construction; this showed an increase of 67·8% between 1902 and 1907, while, as we have seen, the increase of mileage was only 52·4. This is not entirely due to the large adoption of electricity, but rather to the fact that electricity having brought about an acceleration of traffic, an increased car mileage, and a heavy addition to the size of rolling stock, has compelled better work to be put into the permanent way. Indeed, in this matter, the United States is fast approaching the United Kingdom, where, owing to the stringent rules of the Board of Trade, much superior engineering work has hitherto been the rule. It is clear that development is not progressing a bit faster than it ought to do, for the increase of passenger traffic amounts to 63·3%; while, which is satisfactory, the gross income has increased by 71·6%, of which 68·9% was due to operating earnings. It is significant of that better engineering position alluded to above that the per cent. ratio of operating expenses to operating revenue in 1907 was 60·1 as compared with 57·5 in 1902. With us, taking the country as a whole, the earnings of tramways have slightly increased, and the operating expenses, certainly so far as electric lines are concerned, decreased. We mention, incidentally, that the number of power houses has risen from 805 in 1902 to 829, and the kilowatt capacity of dynamos from 898,362 to 1,723,416, or 91·8%, which speaks eloquently of better service all round. Mr. T. Comerford Martin, the late co-editor of the New York *Electrical World*, who is responsible for the technical section of the report, gives much further important information as regards equipment. For the moment, however, it must suffice to place the above facts before our readers, as evidence of the triumphant progress of electrification in the United States, and an encouragement for us to push forward in this direction and hasten to wipe out the few anomalies of horse and other tramways still existing, and to further that move towards the use of electricity for suburban traffic on main lines.

ELECTRO-METALLURGY OF FERRO-ALLOYS AND STEEL.

By Paul Girod.

Before the Faraday Society, Dr. F. Mollwo Perkin, treasurer, in the chair, M. Paul Girod sent in a paper entitled "Studies in the Electro-metallurgy of Ferro-Alloys and Steel," which in the unavoidable absence of the author was read by Mr. F. W. Harbord. The first portion of the paper described the various ferro-alloys manufactured in Girod furnaces at the works of the Girod Co. at Courtepin (3,000 h.p.) and, principally, at the new works at Ugine (20,000 h.p.), where the furnace electrodes are made.

FERRO-VANADIUM.—Two varieties are made, one containing 45 to 55% vanadium and 3 to 3·5% carbon, and the other 30 to 40% vanadium with 0·5 to 1·5 per cent. carbon. This alloy is employed almost entirely in the manufacture of rapid tool steels with great cutting powers.

FERRO-TUNGSTEN.—Three alloys are made, containing respectively 83, 78·5, and 73% tungsten and 0·6, 1·7, and 3·5% carbon, mostly used for steels to be tempered in air.

FERRO-MOLYBDENUM.—This alloy carries 75 to 80% molybdenum and 3 to 4% carbon. The sulphur is removed from the high sulphurous ores in the electric furnace in one operation. Experience has shown that the high carbon content facilitates the fusion and the mixture of this and the vanadium alloys.

FERRO-CHROMIUM.—The principal alloys made contain about 60% chrromium and from 0·6 to 9% carbon, with 0·2 to 2·25% silicon.

For the removal of oxygen from fine steels silico-manganese-aluminium and silico-calcium-aluminium alloys are made.

FERRO-SILICON.—This is the alloy most largely used, and the varieties made contain 25–30, 40–75, 75–80, and 90–95% silicon. The first of these is employed principally in converters, and the richer alloys chiefly for the removal of oxygen and for silicon-steel to be converted into transformer iron.

There are 30 furnaces at Ugine, 18 utilising 300–750 h.p., and 9 about 500 h.p.

THE ELECTRIC STEEL FURNACE.—The second portion of the paper describes the Girod steel furnace with conducting hearth now in wide use for converting scrap-iron into best quality steels. A feature of the furnace is that the metal conductors have only to be slightly water-cooled, at the parts not in contact with the molten metal, and their life is almost infinite. The large furnaces have a capacity of 15 tons.

The mean content of the charge used at Ugine includes 0·3 to 0·4% carbon, 0·1 to 0·3 silicon, 0·6 to 0·8 manganese, 0·07 to 0·12 sulphur, and 0.07 to 0·12 phosphorus, while the best refined product contains 0·05 to 1·5% carbon, 0·15 to 0·25 silicon, 0·25 to 0·35 manganese, 0·015 sulphur. and 0.015 phosphorus. The paper concluded with an outline of the two processes, oxidation and reduction, which constitute the refiningaction of the electric furnace. Tables showing the mechanical qualities of the products are appended.

DISCUSSION.

The *Chairman*, in opening the discussion, remarked on the comparative backwardness of this country in the adoption of electric steel refining. The question of cheap power in this connection was not so vital as was sometimes supposed.

Dr. W. Rosenhain thought that if the claim that best tool steel could be made from scrap was true, it would revolutionise the Sheffield steel industry. He believed the Sheffield manufacturers were alive to this, and were experimenting in a careful and systematic manner.

Mr. W. R. Cooper also remarked on the fallacy of attaching undue importance to cheap power.

Mr. E. Ristori pointed out that practically all types of electric furnaces in use absorbed about the same amount of energy per ton of steel. England had not taken the lead in this matter of electric refining, and she was not following quickly enough.

Mr. F. W. Harbord, referring to the remarks of the previous speaker, said the value of the results obtained in an electric furnace depended on the facilities present for removing slag carrying the impurities. Recent forms of induction furnaces now made provision for this. He personally had no doubt that steel equal to the best crucible steel could be made from scrap in the electric furnace.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

FLEETWOOD URBAN DISTRICT COUNCIL.

EXTENSIONS AT ELECTRICITY WORKS.

CONTRACT No. 1.

The Fleetwood Urban District Council invite TENDERS for carrying out the PROPOSED EXTENSIONS of the BUILDINGS at their ELECTRICITY GENERATING STATION, Copse-road.

Specification, General Conditions, and Form of Tender may be obtained and Drawings inspected on application to the Council's Surveyor, Mr. E. Frobisher, A.M.I.C.E., at the Town Hall, Fleetwood, and on payment of the sum of two guineas, which will be returned on receipt of a bona-fide tender.

Sealed Tenders, endorsed "Extensions," must be received by me at my office not later than 12 o'clock noon on Friday, the 15th day of July, 1910.

The lowest or any tender will not necessarily be accepted.

By Order,

FREDERICK W. WOOD,
Clerk to the Council.

Town Hall, Fleetwood,
June 27, 1910.

SCHOOL BOARD OF EDINBURGH.

The BOARD are prepared to receive TENDERS for the ELECTRIC LIGHT INSTALLATION in connection with the WORKSHOPS at the Tynecastle Supplementary School.

Plans may be seen and Schedules of Measurements obtained at the Offices of Mr. Carfrae, architect, 3, Queen-street, on and after Monday, July 4.

Tenders, marked on outside "Electric Lighting, Tynecastle Workshops," to be lodged with the undersigned not later than Tuesday, July 12.

The Board do not bind themselves to accept the lowest or any offer.

J. W. PECK,
Clerk to the Board.

School Board Offices, Castle-terrace, Edinburgh,
July 1, 1910.

METROPOLITAN BOROUGH OF WOOLWICH.

ELECTRICITY DEPARTMENT.

CENTRAL OFFICE AND SHOWROOM.

The Council of the above Borough will be glad to hear from Manufacturers, Electrical Contractors and others who may be desirous of submitting any Electrical Apparatus or Speciality for Exhibition purposes in connection with the above, which will be opened in a few days.

Offers should be addressed to the Borough Electrical Engineer, Town Hall, Woolwich.

By Order,
ARTHUR B. BRYCESON,
Town Clerk.

Town Hall, Woolwich,
July 5, 1910.

BOUND VOLUMES

— OF —

THE ELECTRICAL ENGINEER

Vol. XLV.

JANUARY to JUNE, 1910.

NOW READY. PRICE 8s. 6d.

TENDERS ACCEPTED—Home.

BELFAST.—The Tramways and Electricity Committee have accepted Messrs. Courtney & Company's tender for the erection of a chimney shaft at the Electric Station.

LONDON.—County Council have received the following tenders for wiring and fittings for the electric lighting of Hammersmith-bridge: Pinching & Walton, Cannon-street, E.C., £230 19s. 6d. (accepted); Foote & Milne, Ltd., Victoria-street, S.W., £256; G. E. Taylor & Company, Bush-lane, E.C., £328.

CONTRACTS OPEN.

HOME.

BRIDLINGTON.—Governors of the Grammar School invite tenders for electrical installation on the O.S. system. Supply from Corporation mains. Specifications (21s.) from Mr. A. J. Beckett, Electricity Works, Bridlington. July 11.

BRIGHTON.—Education Committee invite tenders for installation of electric light in the Park-street Council School. Particulars from E. Hackforth, Clerk to the Committee. July 13.

DEWSBURY.—Education Department, Dewsbury, invite tenders for electrical and hot-water installation at the Batley Carr Schools. Particulars from Holtom & Fox, Corporation-street, architects. July 14.

HORNSEY.—Borough Council invite tenders for wiring, &c., school. (Specification, 10s. 6d., Borough Electrical Engineer, Tottenham-lane, N.). July 9.

LEEDS.—Corporation invite tenders for supply of copper lamps, lamp pillars, lamp furniture, pillar lamp irons and carriages, wall bracket irons, sheet copper and copper tops, and glass. Particulars from Superintendent of Street Lighting, Springwell-street Depôt. July 20.

LONDON.—County Council invite tenders for (*a*) the wiring and fitting for electric lighting of the second section of the Central Car Repair Depôt, Woolwich-road, and (*b*) the supply and delivery of low tension cables, cable boxes, &c., at the Central Car Repair Depôt. Specifications (40s.) from the Clerk of the Council, County Hall, Spring-gardens, S.W. July 12.

ROTHERHAM.—Borough Council.—Annual stores for tramways. (Particulars from Manager, Depot). July 9.

ROTHERHAM.—Borough Council invite tenders for: No. 1, annual supply of single vulcanized bitumen covered cable and of ampere hour meters (2, 5, 10, 25, 50 amperes, 230-460 v.). (Particulars from Borough Electrical Engineer). July 9.

TUNBRIDGE WELLS.—Borough Council invite tenders for high and low tension paper-insulated cables. (Particulars from Borough Electrical Engineer, Stanley-road). July 9.

NOTES.

Indian Agency.

Messrs. Burns & Company, Ltd., of Calcutta, have been appointed agents in India for the British Electric Plant Company, Ltd., of Alloa, Scotland.

"Conduit Wiring."

Mr. L. W. Waterhouse, A.M.I.E.E., A.M.Inst.C.E., Managing Director of Simplex Conduits, Ltd., has brought out a new edition, the third, of his most useful little book on "Conduit Wiring." We understand that brings up the total issue to 20,000 copies. It has always been helpful in matters of installation, but it is more than ever so, because the whole has been most carefully revised and largely re-written. Moreover, special chapters have been added relating to the causes of breakdown in electrical work, notes on lamps and illumination, cables, electric ventilating, and other subjects

OSRAM·LAMPS

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PATENTS.

3. SOKAL, Chartered Patent Agent,
AND
Certified Austrian Patent Attorney (Patentanwalt),
Specialist for German Patents and Patent Litigation.
55, CHANCERY LANE, LONDON, W.C.

THE PROPRIETOR OF BRITISH PATENTS Nos. 14304 of 1899, and 16489 of 1902, relating to "Improvements in and in the application of electric motors for automobile vehicles," desires to enter into arrangements by way of license or otherwise on reasonable terms, for the purpose of developing and practically working the same in this country. Enquiries should be addressed to W. P. THOMPSON & Co., Chartered Patent Agents, 285, High Holborn, London, W.C.

PLANT FOR SALE.

Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

FOR SALE, FIRST-RATE COUNTRY HOUSE ELECTRIC PLANT, to be seen running any day. 2-16 h.p. Hornsby's Oil Engine, with full accessories, Water Tanks and Blow Lamps; one 12 h.p. Dynamo; quantity of ⅝ in. Copper Rod; 55 large Glass Cells; about 6 tons of Lead Plates; 2 small Continuous Fan Motors; one 14 amp. Motor; two 9 amp. Motors; two 5 amp. Motors.—Apply PRETOR-PINNEY, Broadoaks, West Byfleet.

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SITUATIONS VACANT.

MEN OUT OF EMPLOYMENT in all branches of the Electrical Trade should write to Box No. 20, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

SITUATIONS WANTED.

MANUFACTURER'S REPRESENTATIVE desires change; London or Provinces.—Box A., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

MOTORMAN, excellent references, 5 years' experience with St. Helens Tramway Company.—Box S., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WIREMAN, 5 years' experience; age 25.—Box T., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, aged 16, seeks engagement, Electrical Engineer. North London preferred. Intelligent, good education.—R. C., ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WIREMAN, disengaged, 12 years' experience. Casing, Simplex, Barrel.—G. L., 14, Sterndale-road, West Kensington.

ELECTRICAL MAINS FOREMAN, thoroughly acquainted with all branches of the work, both high and low tension cables laid on all systems; also knowledge of overhead and construction and permanent way. Excellent references.—G. P., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

which are of interest since the business of the Simplex Company has been extended during the last two years to cover various electric lighting and power supplies. Tables relating to wiring capacity of conduits, copper conductors, and so on, are included at the beginning, whilst at the end of the book are photographs of typical installations. The opinions quoted of the Fire Office Engineers in Chapter I. will be of interest in view of the development which has taken place in wiring systems recently. These opinions, being publicly expressed by leading electrical experts whose practical experience covers all classes of work, are of considerable value, and leave no room for doubt that conduit wiring when properly carried out, is regarded as providing the maximum safety from possible outbreak of fire due to electrical causes, Much of the matter contained in the work is the outcome of many suggestions and criticisms, the latter not always favourable, which have been received by the Simplex Company during the last 12 years.

Switch-boxes and Control Panels.

Messrs. Siemens Bros. Dynamo Works, Ltd., have issued a price sheet dealing with their new lines of Stafford-made control boxes and pillars. This apparatus is of the highest quality, and is constructed to meet the most stringent requirements of safety and reliability. By utilising their "Zed" type fuses, which are being very widely adopted for all classes of work, the firm have been able to design an extremely compact switch and fuse box, which is as safe and completely foolproof as anything on the market. The perfect operation of these fuses under all conditions for which they are intended can be fully guaranteed.

Foster Metallic Lamps.

The Foster Arc Lamp & Engineering Company, Ltd., have issued a three-leaved folder, which they supply to contractors to advertise their Foster metallic lamps, and well-known auto-transformers, but more especially the former. A space is left in which they print the dealers' name and address. These leaflets are intended for distribution over the counter, or for enclosure in correspondence. We may truly say that the Foster metallic lamp is winning golden opinions wherever it is used.

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Electric Lighting at the Army Pageant.

During the evening performances at the Army Pageant the grounds of Fulham Palace were lighted by arc lamps, metal filament lamps, and searchlights. The arc lamps consisted of 20 British Westinghouse "Arcturus" flame arcs, 10 ampere size, burning 4 in series on a 200 volt, 50 period, A.C. circuit. Six of these were fixed at the back of the grand stand, suspended from the roof in such a manner as to illuminate the grounds at the back of the stand, as well as the stand itself. Fourteen of these lamps were carried on wooden poles between the grand stand and the entrance, lighting the grounds generally. Metal filament lamps were used for lighting the grand stand. Two 40 ampere electric searchlights were used for the purpose of illuminating the performances. The "Arcturus" lamps and the searchlights were supplied by the British Westinghouse Company through their Supply Department, 3, West-street, Charing Cross-road, W.C.

Ingenious Novelties.

Particulars will be found in our advertising columns of a trio of ingenious inventions put forward by Messrs. G. Watson & Company, of Jessel-chambers, Chancery-lane.

We illustrate a formidable-looking pistol, which is loaded with a cartridge, and when fired gives a sharp report and a flash. In place, however, of a deadly bullet, it emits a stupefying vapour, which has the effect of rendering a burglar or assailant insensible for five or ten minutes, enough to enable adequate measures to be taken, but doing no permanent harm. This pistol, or the still more business-like-looking revolver turned out by the same firm, in combination with an electric burglar alarm, ought to make every citizen feel quite safe. Another safety appliance is the steel and flint gas lighter, while an invention conducing to personal comfort is the cigarette, cigar, and pipe lighter, also illustrated herewith. It requires no matches. You merely press a button and obtain a light, no matter how high the wind may blow, or persistently the rain may fall. These novelties should undoubtedly prove popular.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is to be presumed, from the nature of the cases, that this will be so.

AMBLE: Surveyor, Amble. Alteration of schools for public offices.

BELFAST: Watt, Tulloch & Fitzsimons, architects, Victoria street, Belfast. Ware house in Queen-street.

DEWSBURY: Holtom & Fox, architects, Corporation-street. School.

DUNDEE: School Board. West End Academy, at cost of £30,000, and remodelling of Harris Academy.

GREAT CROSBY, NEAR LIVERPOOL.—A. Coates, architect, Rawtenstall. Weaving shed for Messrs. R. Kershaw & Company, of Manchester, at Endbutt-lane.

LEEDS: Education Department. Armley Park Special School.

OAKENSHAW: E. V. King, architect. Wesleyan Chapel.

PONTEFRACT: Education Department. Girls' High School.

SOUTHALL: G.P.O. Surveyor, 12, St. Andrew's-square, Surbiton. Post Office.

WROTHAM: Kent Education Committee. School for 250 children.

NEW ECLIPSE FLAME ARC LAMPS.

Made by Braulik Engineering Co.

The Braulik Engineering Co., of Lambeth Hill, Queen Victoria-street, E.C., are placing on the market in preparation for the coming winter season, two new types of flame arc lamps. These lamps embody several new features

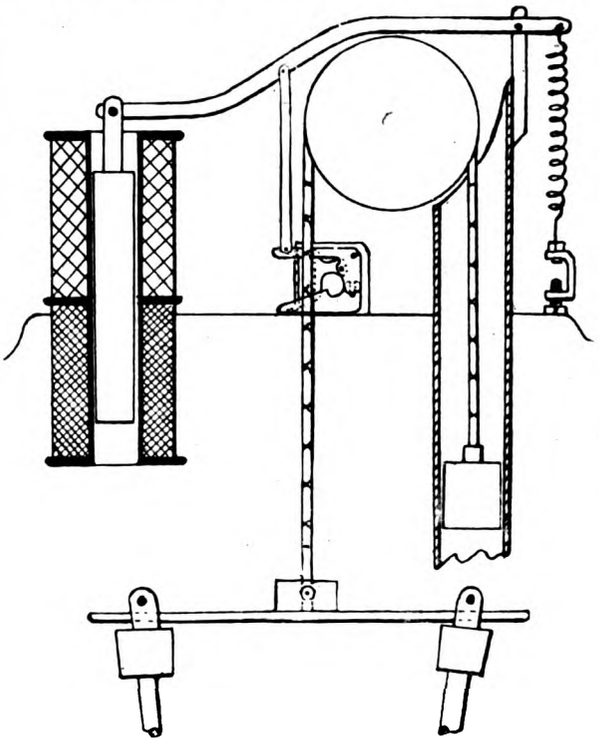

FIG. 1.

which may be of interest to our readers. In both types, the arc is struck by drawing back *both* carbons, so that there is no horizontal movement of the carbon as in the

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Bremmer patent. In the direct current arc lamp, shown in Fig. 2, the striking of the arc is effected by a clutch gripping directly on to the chain which supports the carbons. In order to be able to do this, the manufacturers have had to design and make a special form of chain having a smooth outer surface. The clutch also, as shown in Fig. 1, is specially arranged with large surfaces and with a parallel motion, so that both grip and release are extremely delicate. The mechanism and coils are fixed on the upper part of a plate about 18 in. above the arc, there being only a small hole where the chain passes through.

Fig. 2.

The alternating current arc lamp, made by the same firm, is of the motor type, there being an aluminium disc about 4 in. in diameter revolving between two sets of magnets, one in shunt with the arc and the other in series, the series coils striking the arc by passing the carbons, whilst the shunt coils feed the carbons together. By interaction on the disc these two sets of coils keep the arc at exact voltage and length. In the design of this lamp the clockwork is kept quite outside the control mechanism, and is thus very easy of access. The shunt coils are so proportioned that after running many hours the windings are still quite cool. This is an important matter, as it is the shunt coils which generally burn out in such lamps. When the carbons are fed to their lowest safe point the shunt coil is cut out mechanically, and then the series coils are free to rotate the disc until the carbons are drawn back to such a distance that the blow magnet suppresses the arc.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION (Incorporated).—The next Committee meeting of this Association will be held at Balfour House, Finsbury-pavement, on Tuesday, the 12th inst., at 2.30 p.m.

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MANCHURIA.

The following information is from the report by the British Acting Vice-Consul at Dairen on the trade of that district in 1909 :—

At Dairen there is at present a supply of electric power of 1,500 kw., of which 400 are required for the electric tramway. The supply is not as yet equal to the demand, and applications for installations continue to be refused, but with the addition of 2,000 kw. in the course of 1910 the power house should be able to meet all calls. The number of lights has now reached 16,000. Of the machinery added in 1909 and to be laid down in 1910, the generators and engines are of American make, while the boilers, rotary convertors and steam condensers have been obtained in the United Kingdom. At Changchun all the plant was laid down, and the settlement was to be lighted from the beginning of 1910. At Mukden there is to be a further extension in 1910, and the engine, boiler and dynamo have all been ordered from the United Kingdom.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

The performance of the Newcastle-upon-Tyne Tramways system has been very much discussed by the City Fathers this week, on the advent of the annual report of the Tramways Committee. One interesting point developed was that the traffic cost per car mile was 3·158d., as compared with 2·851d. at Bradford and 2·90 at Leeds. Criticism was made which suggested that the car drivers were practising as aeroplaneurs, one councillor thinking that the cars would pick up more passengers if they did not rush past points which might be regarded as stops. This disadvantage of a quick time-schedule is worthy of note; we are not all so nimble as our Yankee cousins. In defence of the position, it was stated that the cars carried per week three times the total population of Newcastle.

Parcels and the Blind.

Two interesting suggestions are at present before the Tramway Committee. The first is that of a parcel-carrying service. It is estimated that by charging a penny per parcel an average of £5,000 per year could be earned, and in a few days it is proposed to set some sort of scheme for a parcel-carrying agency before the Newcastle Council. The second idea, which is to be introduced to the Tramway Committee at an early meeting, is that blind persons should be allowed to travel free of charge upon the cars, on account of the difficulty such people have at times to secure adequate guidance. Although the motive for this suggestion is good and philanthropic, there appears to be a danger of adding too much to the conductor's responsibilities, as it is by no means easy to pilot a blind person safely on to or off a car standing in crowded streets.

Tramway Work and Trades Unionism.

Trades Unionism appears to be making headway in tramway matters in this area. Some time ago there was quite a serious disturbance on the Newcastle Corporation system, while since that time there has been more than one occasion when the men's representative and organiser has sought an interview of the Council. It now appears as if the storm-centre is shifting to Sunderland, where the tramwaymen and electrical workers have resolved that in the event of any serious trouble arising in connection with either section they propose to act in co-operation for mutual assistance. Whether this means active propaganda work or passive resistance it is difficult to predetermine.

A Growing Northumbrian Port.

There appears to be every indication that Blyth is a growing industrial centre whose importance will be more properly appreciated later. From notes appearing in these columns, it will be remembered that the North-Eastern Railway Company and the Harbour Commissioners appear to be acting together for development purposes. Harbour extensions are now probable, involving the provision of a new pier placed in such a position as to largely increase the capacity of the harbour. A new company, with Lord Ridley at its head, has lately been formed to develop the white fish trade of the port, the capital of the company being £200,000. An ice-making factory is about to be constructed, and new boats are to be built. Taking all this into conjunction with the present importance of Blyth to the Northumberland coalfields, and the fact that the Newcastle-upon-Tyne Electric Supply Company, Ltd., is perfecting its system of power-in-bulk supply to Blyth, there appears to be no doubt that Blyth is a coming place.

Electric Lighting, Public and Private.

Electric lighting business in this area is not showing much recovery from its long-continued slackness, but two items of interest may be noted. The first, as regards public lighting, is the acceptance by the Urban Council of Spennymoor of the tender made by the Northern Counties Electric Supply Company, Ltd., for lighting the district at the rate of £2 10s. per lamp for the coming season. The second is that at Jarrow, on the south bank of the Tyne, there is shortly to be opened what will probably be one of the most elaborate "electric theatres" in the North of England. The lighting of the auditorium will be lavishly effected by clusters which will be controlled, by means of a pair of double break switches from either control point, either from the operator's cabin or from the stage. Various other features of novelty are spoken of, one being that it is possible that an installation of the Moore light may be made. Further particulars will probably be made known later.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The principal manufacturing firms in the Midlands are fully occupied, and there is a large amount of overtime being worked in some branches. The departments which are busiest are those for the production of turbo-generators. At Stafford, Siemens Bros. are still working at full pressure on this and other work. The British Thomson-Houston Company's works at Rugby are exceedingly busy in nearly every department, and are turning out turbo-generator sets for a number of important contracts. One contract just obtained has been for the Coventry Corporation, whose generating station has hitherto been run solely by reciprocating engine sets. The turbo-generator set now in course of construction for this department by the British Thomson-Houston Company will have a capacity of 2,500 kw., calculated at 100% power factor, or 3,125 k.v.a. at 80% power factor. The set will have a voltage of 2,000 volts, two-phase, 50 cycles. The speed will be 1,500 r.p.m., and the steam factor 180 lbs. The turbine is a five-stage horizontal impulse turbine of the Curtis type, and will have an overload output of 3,906 k.v.a. at 80% power factor. The set is to be installed within about four months. The company have just supplied to Baylis, Jones & Baylis, Ltd., Wolverhampton, two 250 kw. rotary converter sets complete with high tension and low tension switchgear. The British Thomson-Houston Company is also exceedingly busy in the switchboard and switchgear departments.

Droitwich and Electricity.

A discussion that took place last week in the Droitwich Town Council seems to show that the salt borough is somewhat behind the times in regard to electrical developments. A letter was received from Mr. F. T. Evered asking whether the Council would place any obstacles in the way of a scheme for the installation in the town of electric lighting and asking for the Council's co-operation in such a scheme. The discussion on the subject seems to have been carried on chiefly by the Mayor and Alderman Holyoake, and to have turned not upon the question whether it would not be better for the Council itself to take in hand the supply of electricity, but upon the interests of the gas undertaking, of which the Corporation are the owners. The Mayor and Alderman Holyoake considered that, as trustees of the ratepayers, the Council should oppose the suggested scheme as being detrimental to the gas undertaking, and Alderman Holyoake said that he knew several towns in which the electric light was not successful. The Council promptly agreed *nem. con.* to oppose any order that might be applied

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for. Considering that Droitwich, on the strength of its salt baths, and its surroundings, has been diligently exploiting itself for several years past as a kind of inland watering-place, and has provided somewhat luxurious accommodation for visitors, it might be thought that an opportunity of adding electric lighting to the attractions of the place would not have been so hastily put aside. Some of the ratepayers possibly may think that the Council would have been consulting their interests more effectively if it had either come to terms with the enterprising Mr. Evered or had appointed a committee to consider the possibilities of adding an electricity department to its other profit-earning undertaking.

Electricity v. Gas.

Competition with the gas undertaking by the electric supply is being severely felt in the borough of Smethwick, and has led to much dissatisfaction in some local circles with the arrangement under which the Corporation some time ago allowed powers for electric supply of the borough to be obtained by the Birmingham and Midland Tramways Company. The business of electric supply has been carried out by the Company with considerable enterprise, and owing to the number of large works in the district which find it to their advantage to adopt electrical power, has proved so successful as to accentuate the disappointment of those who would have liked to see the supply in the hands of the Corporation. There is, however, no help for it, as the agreement has a good many years yet to run, and the company is not likely to relinquish a profitable and a growing business as long as it has power to retain it. The recent proceedings in Parliament with regard to the transfer of the Tramway Company's electric supply powers to the Shropshire Electric Power Company have therefore had little substantial interest from a municipal point of view. Though the Corporation petitioned against the proposed order, on a point with regard to the financial position of the Shropshire Company, no real opposition was offered, and as the preamble has been proved, it may be taken that matters, as far as the potential acquisition of the undertaking by the Corporation is concerned, will remain just as they were.

Extensions at Hanley.

In spite of the Federation of the six Potteries towns into the county borough of Stoke-upon-Trent, and the consolidation of the four electricity undertakings under one chief, considerable additions to the plant are contemplated. For the Hanley works, six 30 kw. transformers have been ordered from the British Westinghouse Company, Ltd., at the contract rate of £44 10s. each. Some important extensions of the distributing mains from the Stoke-upon-Trent works are being made, as also from the Longton works. The total cost of the extension of the plant contemplated at Stoke-upon-Trent is put at £9,460, while the supply to Fenton from these works is estimated to cost £6,072. These two large items, however, have been deferred for the present. There is also a proposal to put in at Hanley a new 1,000 kw. set and new boilers.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

During the past month business has increased considerably in this district, and already people are beginning to complain of being overworked. There is every indication that all the expectations which were raised at the beginning of the year will be fulfilled, and that a real boom in trade, such as has not been known for years, is commencing. Under these circumstances, it is earnestly to be desired that full advantage will be taken of the coming period of prosperity to push forward the supply of energy for all powers industrial and domestic, so that by the time the next period of depression comes round there will have developed a much wider demand for those articles which are required for replacements and repairs, and the whole basis of electricity supply will have been broadened. Every unit increase in the load connected of any one station in the country represents an investment which will produce in addition to immediate business, through the depreciation and mishaps to which all mechanical apparatus—even that used in electricity applications—is liable, a sort of interest. The larger this investment, the larger the interest, and there must obviously be a time when this interest can pay the standing works expenses in periods of trade depression.

Developments at Stretford.

It will be remembered that recently one of the local football clubs opened a new ground in Trafford Park. As a result the Manchester Corporation trams, which, of course, bring enormous crowds to the matches, have to pass beyond the city boundary to reach the ground. At this point outside the city the Stretford District Council supply all the energy for traction, but the plant capacity was not equal to such an enormous increase, so after an unsuccessful lawsuit with the Manchester Corporation, the Council have had to arrange for a 500 kw. extension, part of which, however, was needed for increases in the ordinary demand. The contract for the 500 kw. generator has been given to the General Electric Company, and for the new 30 ft. by 8 ft. Lancashire boiler to Heaton & Son. Tenders for a surface condenser to deal with 1,000 kw. extension; filtering plant; an 800 and three-phase lighting booster; and some new cells, are under consideration, and contracts will shortly be let. A Hodgkinson coal conveyor for carrying the coal direct from the canal to the boilers has recently been put in, and is working very satisfactorily.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The Prussian State Railway Department has erected at Halsensee, near Berlin, a gigantic pumping and water softening installation, described at great length in the *Elektrische Kraftbetriebe und Bahnen* for June 24. The whole of the power is electrical, and the hard water is pumped out of deep wells, softened and distributed to the stations of Halensee, Grunewald, Westend and Charlottenburg, in quantities averaging considerably over a million gallons a day. The cost was 550,000 marks, and the yearly expenses of all kinds, including depreciation and all other items, is 106,081 marks. This brings the cost of the water to 7·24 pf. per cubic metre, or say 4d. per 1,000 gallons. The wells are about 150 ft. deep, and the pumps are driven by motors worked by a polyphase current of 50 periods at 225 volts.

Economies of Electric Power Stations in German Large Towns.

R. Kitdchelt, writing in the *E.T.Z.*, gives some valuable statistics on this point, which are well deserving of attention. The figures are derived from 37 stations in towns of over 100,000 inhabitants. These are first divided into four groups, according to the nature of the current generated.

Group A includes five stations, supplying direct current only.

" B includes nine stations, supplying direct current obtained by transforming polyphase current.

" C includes nine stations, supplying both direct and polyphase current.

" D includes fourteen stations, supplying polyphase current only.

We then have the following table:

	A	B	C	D
Kw. supplied ..	17,126	97,410	63,325	123,622
Plant cost in marks ..	1,630	1,410	1,210	1,270
Energy loss per cent. ..	17·8	22·1	19·7	19·0
Per kw. hour ..	2·00	1·16	0·90	0·93

These figures show the disadvantages of direct current production very clearly.

In considering the effect of the uses to which the current

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is put, the stations are divided into the following three groups:

Group 1 includes eight stations, using more than 50% of their current for lighting.

„ 2 includes twelve stations, using from 30 to 50% of their current for lighting.

„ 3 includes stations, using less than 30% of their current for lighting.

We have then the following table:

	1	2	3
Average price received per kw. hour in pence for light	4·64	4·11	5·06
Average price received per kw. hour in pence for power	2·07	1·81	1·70
Average price received per kw. hour in pence for travelling	—	1·26	1·20
Cost per kw. hour in pence ..	1·51	1·00	0·90

Small Electric Railways in Germany.

Street trams and secondary railways in the German Empire carried 2,103 million passengers in 1908. The receipts were in round figures, nearly two millions sterling, the expenses rather over 1⅓ million, the profits being just over half a million. The capital invested in these concerns exceeds 25 millions sterling.

Electric Blast Furnaces.

In view of the growing importance of the electric furnace for smelting pig-iron from ores, hitherto generally regarded as impracticable, some astounding results achieved by the Unione Italiana Concini are of extreme interest. This company smelts 100,000 tons of iron pyrites annually, and gets iron containing 0·08% of sulphur at the outside, often 0·02% only. This powdery substance cannot possibly be dealt with in an ordinary blast-furnace, as it chokes the furnace completely. The company are not only producing cast-iron at a remunerative cost, but also Bessemer steel, spiegeleisen and silicon-iron. The electric blast furnace is said to be cheaper than the ordinary furnace in all cases where water-power is available near the mine, and especially as coal has usually to be brought from a distance to places which combine these two conditions.

New Benzole Motor Coach.

In 1907 the Hesse State Railways tried a benzole electric carriage on their system. The carriage was the joint production of the A.E.G. and the Gasmotorenfabrik Deutz. Although this first example of its kind was naturally not everything that could be wished—a combination of locomotive and passenger coach—it was so successful that the railway company has now had eight more built, to embody the lessons learned by experience with the pioneer car. One drawback of this was the vibration caused by the running of the motor, especially when the coach was at a standstill. In the new cars this is prevented by lowering the speed of the motor from the normal rate of 700 turns a minute to 200 to 250 when the car is standing, by means of an auxiliary motor. The new cars seat 100 passengers and can carry enough benzole to take them 125 miles without stopping. They develop a speed of 30 miles per hour on the level when full and 20 miles per hour on a bank of 1 in 60. The benzole motor gives 100 h.p. The dynamo connected to it by an elastic coupling gives 50 to 66 kw. and 300 volts. The benzole reservoir holds 38 gallons. The cooler is on the roof of the driver's compartment and air is driven through it by an electric fan. The motors are started by compressed air. A 70-volt exciting machine supplies not only the exciting current for the main machine, but the current for lighting the car and for other subsidiary purposes. A secondary battery is carried in case it should be wanted. The new cars are creating much attention and the Oldenburg State Railways have already ordered similar ones from the same makers, the A.E.G., the Gasmotorenfabrik Deutz, and the Dusseldorfer Eisenbahnbedarf.

An Electric Excavator.

The firm of Menek & Hambrock, of Altona, have made an electric excavator for the Neumahl coal mines, which will no doubt be of interest to your readers, as it has now been at work for a considerable time to the perfect satisfaction of everybody concerned. The electric motors were supplied by the A.E.G. They are three in number, actuated by a polyphase current of 500 volts and 50 periods, and run under load at 480 revolutions a minute. This slow speed is necessary to ensure quick starting and stopping. The lifting motors develop 80 h.p., the motor for swinging the load about 15 h.p. The current is brought through a cable about 400 ft. long, and just so much of it is wrapped around the drum as is required. The shovel can be attended to by a single man, whereas with single motor excavators two are required. The shovel load is 1 cubic metre (35 cubic ft.) and the greatest lifting power is about 8 tons. The greatest range over which the shovel can be emptied is about 7 yards from the main axle of the excavator.

Water Power in Bavaria.

It is interesting to note that the utilisation of water power for electrical purposes has made such strides in Germany that the Bavarian Government has created a special department, presided over by Herr Stengler, to investigate the water resources for power production in the country, to make proposals for the utilisation of those resources by the State, to examine applications for concessions emanating from municipalities and private firms, and, lastly, to act as an information bureau for all wanting to employ water power for electrical purposes. The new department will co-operate with the hydrotechnical already existing under Ministerialrat Hensel, who has already accumulated many important statistics as to amount of water obtainable from various rivers and streams at different times of the year. Both departments are under the Minister of the Interior, or as he would be called in England, the Home Secretary. Some of the results of the joint labours of the combined offices may now be given. It is estimated that in Bavaria, for at least seven months in the year, 560,000 h.p. can be obtained south of the Danube, and 9,000 more north of it. The cost of utilising this power up to the point of driving the turbines is put at a price for installation not exceeding 1,000 marks per h.p. The worst of it is that nearly all the water power is in the south of Bavaria, while most of the Bavarian industries are carried on in the north. The establishment of new factories, except pulp and nitrogen factories, is made difficult in Southern Bavaria by heavy freight rates. Nevertheless, that is not an insuperable difficulty, but a drawback merely. The increase in our knowledge of cheap transmission of electrical power to a distance from the source of energy is now so complete that there is no reason why as much as may be wanted of the 560,000 h.p. should not be transmitted across the Danube, and arrive at where it is wanted at such a small cost above what would be incurred if the water power was available on the spot that the extra expenditure would have little or no influence on the selling price of the manufactured goods.

As regards concessions it has been agreed that they shall be granted irrevocably for 40 years, and then revocably for a further time of 30 years. A moderate annual fee will be charged, and at the expiration of the concession no compensation will be payable by the State. At the same time the concessionaire will be bound to sell the electric energy at a reasonable rate for all purposes of public utility.

Company Notices.

It is a sign of the times that so many small electrical concerns have been started in Germany, with capitals such as £2,000, or even less, which the "high" financier sneers at. We hope to say something more about this subject later, but we can say now that these concerns are causing some anxiety to the large firms, and that one or two of them have been approached. This, of course, means purchase, stock, lock and barrel, and annihilation. We must wait and see, but it is surely a significant fact that Germany should be the birthplace of these audacious little concerns. The mere fact of their existence shows even

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more eloquently than some of the big German dividends that there is not only a lively public interest in electrical matters, but that electrical mathematicians and engineers are being called upon to give at least a little of their attention to what they call small concerns.

The Elektricitats Actiengesellschaft vorm. W. Lameyer & Co., of Frankfort, made a net profit for last year of 1,454,472 marks, as against 1,506,210 marks in the previous year. The dividend will be 5% on the present capital of 25 million marks. Last year it was 6% on the smaller capital of 21¼ million marks.

The annual report of the Hamburg Street Railway Co., has been issued. The receipts for 1909 were 16,704,098, as against 16,343,640 in 1908. The number of passengers carried rose from 124,099,895 to 128,488,260. The distances covered in the two years were 42,347,798 km. in 1908, and 43,860,303 km. in 1909. The receipts fell off slightly per car mile, and averaged 6½d. The gross profit was 5,747,629, the net profit 2,928,091 marks, which will be distributed as follows:—10% dividend on the share capital of 21 million marks = 2,100,000 marks, contribution to the town as per agreement, 336,000 marks, gratuities and directors' fees, 170,620, making a total of 2,928,091 marks.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The electric cooker has come to stay. Central Station managers and manufacturers alike recognise that the experimental stage has long since been passed, and that cooking by electricity is a practical proposition which can confidently be adopted by every householder who is now using electricity for lighting purposes. It has to be admitted, however, that the progress of the electric cooking stove has been in some measure retarded by the conservative action of the electric lighting companies. They have, in the past, been very slow to realise that to enable electricity to compete with gas for cooking purposes they must be content at the outset to make a loss for the sake of developing a phase of electrical business rich in potentialities for extension. But this sacrifice having been once resolved upon and put into practice, the result has amply justified the experiment. In the beginning of things Central Station men were content to point out the many advantages of electricity over gas for cooking purposes, and to gloss over the matter of extra cost. Convenience, cleanliness, absence of danger, reliability of heating and all the other special points which will readily occur to the electrician were emphasised, but these did not appreciably affect the consumer, till the cost of current was brought down. All that is now a chapter in the past. Electricity competes to-day with gas on the prime basis of cost alone, and all the other advantages are thrown in. A timely, interesting and very practical article on this subject is contributed to the current issue of the Chicago "Electrical Review" by Mr. Putnam A. Bates, a well-known authority on this particular phase of electrical development. He points out that the rapidity with which food may be cooked by the use of electricity, the uniformity of temperature obtained which makes cooking by the clock a possibility, the great comfort and convenience, the cleanliness and freedom from flame, dirt, smoke and smell incident to this method of cooking, make it ideal. As might be expected, the results obtained with this method are beyond all comparison with those from any of the older methods.

Furnace Electrodes.

Mr. Carl Hering has now brought to a conclusion the important series of articles he has been contributing to the New York "Electrical World" dealing with the design of furnace electrodes. The final instalment is in the nature of a summary of conclusions, and in commenting upon it editorially the "World" observes that furnace electrodes are subject to two kinds of expenditures or losses, namely: (1) thermal conduction losses, whereby heat is conducted through them from the furnace, like water through drain pipes; and (2) joulean or I^2R losses, whereby power must be expended electrically in heating the electrodes by the passage of the working current. These phenomena, although associated in the electrodes, are essentially distinct, obeying separate laws, and acting independently of each other. "Mr. Hering showed algebraically, among other things, that it so happens the total waste of power, due to heat conduction and I^2R combined, will be a minimum in the electrodes when there ceases to be any resultant escape of heat from the furnace through the electrodes; that is when the I^2R heat flow into the furnace equals and cancels, the thermal conduction flow out of the furnace. It has since been shown that although, theoretically speaking, large variations in electric and thermal conductivity along the electrodes might give rise to large deviations from Hering's law if the electrode were long enough, and varied sufficiently in conductivities, yet, under practical conditions of length and conductivities, the corrections involved were negligibly small for engineering purposes. Hering's law of minimum power waste and zero heat escape from the furnace is, therefore, practically sound, and is likely to be classical. It is not merely an intellectual truism, it is also a highly practical rule. If the rule is neglected, there will probably be either a chilling of the furnace by thermal cooling near the entrance of the electrodes, or a superheating of the electrodes in the walls, with a tendency to more rapid disintegration; or an unnecessary waste of power."

Smoke Prevention.

An ingenious method of preventing the condensation of the volatile products of combustion is described by Mr. H. A. Storrs, of Denver, in a recent Bulletin of the National Electric Light Association. The boiler described was one used in constructing a Government project in North Dakota, where electricity is used for pumping water for irrigation purposes. The fuel available was lignite containing 40% of moisture. The ash pit of the boiler was closed, and air was delivered under pressure by steam-jet blowers. Another method of forced draft, besides that through the ashpit, was also adopted. In this latter case, however, the air was preheated by being first passed through heaters located in the breeching of the stacks, and was thus delivered to the combustion chamber at a temperature of about 200 or 250°. The immediate result of this preheating, not counting the gain in efficiency in utilising part of the heat of the waste gases, was to prevent chilling of the volatile products in the combustion chamber, and practically smokeless operation of the boiler was thus effected. The heated air was passed into the furnace under pressure through the ports in the bridge wall and in the arch which was sprung over the fuel bed. The boiler was of the Stirling water-tube variety, and was well adapted for this method of operation. Another contribution bearing on this question of boiler efficiencies and smoke prevention is given in the Bulletin of the University of Illinois Engineering Experiment Station. This deals with the question of combustion in steam boilers and shows that with a partially cooled furnace and combustion chamber, excellent combustion conditions may be maintained so that the overall boiler efficiency may even be increased without making any appreciable or objectionable smoke.

Telephone Ethics.

The New York Telephone Company, in a special circular, preaches the following sermon to its subscribers: "Do over the telephone as you would face to face. The fact that a line of wire and two shining instruments separate you from the persons with whom you are talking takes none of the sting out of the unkind words. Yes, indeed, always remember that a soft answer turneth away wrath. If it should happen occasionally that you are cut off in the middle of a conversation, or you can not hear distinctly or at all, or somebody is reviewing the world's social history while holding the wire, do not take it out on the unfortunate person with whom you are attempting to converse. Try and contain yourself, keep cool, patient and sweet, be it ever so painful. A quiet demeanour and self-abnegation saves wear and tear on the nerves as well as on the property of the telephone company. Anger, mixed with profanity of any sort, burns out too many fuses."

Hints for Students.

In the course of a seasonal greeting to electrical engineering students the "Electrical Review and Western Electrician" of Chicago strongly urges college graduates to lose

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no time in entering the shop. The shop, observes the writer, is usually the least attractive of the openings which are available to the embryo engineer. "The hours are sometimes long, the work is dirty, and the pay at the beginning is usually poor. The office of a consulting engineer, the designing or drafting room of a manufactory, or the testing room of the works looks much more attractive. The unpleasant features of shop work are lacking, and moreover, there will be opportunity to apply some of the knowledge which he has been absorbing, and to absorb more of the same kind. He will be surrounded by a more congenial atmosphere, by more men of his own kind. But these are the very things he should avoid. A college education leaves a man deficient in certain things which the engineer must know, and they can be learned nowhere so well as in the shop. The contact with workmen and their ideas and points of view, the details of shop organisation, operation and practice, the familiarity with shop conditions of every kind, will be most helpful factors in the future advancement of the engineer. The college graduate must learn to serve, to make himself useful, to obey orders." The word "shop" is used, of course, in a broad sense, as the place where the manual labour is done. In a central station, the engine room takes its place. With the operating telephone company, the line-man is doing similar work. "The essential thing is to learn how to do, and not to know merely what ought to be done."

Gas-Electric Cars.

The experiments with gas-electric cars on the Southern Railway Company have proved so successful that a considerable extension of the system is under consideration. After a careful study of the conditions on those sections of the line where suburban business is heaviest and there is a demand for a more frequent service, it has been deemed advisable to put gas-electric cars into service, either substituting them for the present local steam trains, or supplementing the steam service so as to give more frequent service. One of the localities where this service may first be put in operation is in the active manufacturing territory of South Carolina, which the conditions would seem to suggest that such service would most conveniently accommodate the milling towns of Seneca, Anderson, Belton, Williamston, Pelzer, Piedmont, Greenville and Spartanburg. In the cars ordered for the Southern Railway lines the generating engines and electrical machinery are in the forward end of the car. The cars are handsomely decorated, lighted throughout by electricity, and can be run at any speed up to 60 miles an hour. The motive power is sufficient to enable the cars to haul a trailer or extra coach.

New Cable Conduit.

The H. W. Johns-Manville Company of this city is putting on the market a conduit for underground cables, the manufacture of which embraces some noteworthy new features. The material used is indurated fibre, moulded into shape under high temperature and immense pressure, so as to be entirely without grain or laminations. This process gives each length of conduit a solid, $\frac{3}{8}$-in. one-piece wall, homogeneous, with a tensile strength that is remarkable when compared with the light weight of the conduit. An important feature of the conduit, which is to be known as the "J.M. Fibre Conduit," is the jointing system. One end of each section is moulded to an enlarged size, belled out, with an opening as large as the outside diameter of the opposite end of the next section. Thus, any two sections fit together without any reduction in the wall thickness of either section at the joint. In view of the fact, however, that installation methods on some systems necessitate the use of straight joints, the manufacturers have also arranged to make this new conduit with straight line joints. The joints are smooth inside as they are machine moulded and true, having no offset. Each length of the conduit is also smooth throughout its bore, thus greatly facilitating the work of inserting cables. It is also claimed by that reason of there being no seams or roughness at the joints and as the air-tight joints prevent particles of concrete from seeping through, a No. 6 wire can be pushed through each duct from manhole to manhole, thus doing away with the ropes and rods. Tests made with $\frac{3}{8}$-in. thickness of wall show that the conduit has an average puncture voltage of 40,800 dry and 33,000 volts after 40 hours immersion in water. Danger of electrolysis is, therefore, practically eliminated.

Current Items.

What is said to be the cheapest power-rate in the world is enjoyed by the users of electricity at Harrisonburg, Virginia, where power is supplied for one-fifth of a farthing per kw. hour. The plant which furnishes this power is a hydroelectric installation and is municipally operated.

The 18 in. and 14 in. merchant mills now in operation at the plant of the Indiana Steel Company, at Gary, are remarkable for the fact that alternating current motors are employed throughout for operating the cranes, hoists and tables, as well as the main rolls themselves. For driving the roughing rolls each mill is equipped with a 3,200 h.p., 6,600 volt, three-phase induction motor, while a 650 h.p. motor of similar type operates the finishing rolls. The lifting tables, transfer tables, cut-offs, switches and straightening rolls are driven by about 75 small motors ranging from 7 h.p. to 100 h.p. All of the crane, table and miscellaneous motors about the mill are operated by 220 volt, 25 cycle motors.

The Mount Shasta Power Company, of Redding, Cal., is boring a 7 mile tunnel, which will carry a quarter million inches of Pitt River water across the big bend near Wengler. The water which flows in this tunnel will be sufficient for the development of about 100,000 h.p.

The Aluminium Company of America has planned to extend its power house at Massena, N.Y., allowing for development of 50,000 additional h.p. This will mean an estimated expenditure of $750,000 in addition to the $12,000,000 already expended in installing the mammoth plant.

A plan for power development which is under way on the Deerfield River, includes an 8 mile storage reservoir and a generating station where an 800 ft. head may be available. The power developed may be 25,000 h.p.

COMMITTEE FOR THE PROTECTION OF ELECTRICAL INTERESTS.

The Hon. Arthur Stanley, M.P., has accepted the position of president of the committee, Mr. Robert Hammond agreeing to act as vice-president, Mr. Arthur H. Preece as honorary treasurer, and Mr. R. Borlase Matthews as honorary secretary.

Since our last announcement the following additional members have been nominated: Chas. Bright, F.R.S.E., James Connolly, M.I.E.E., Edward Manville, M.I.E.E., J. H. Rosenthal, M.I.E.E., and F. Ince, A.I.E.E.

Meetings.—It has been arranged that for the present the Committee shall hold fortnightly meetings on alternate Wednesdays. The first of these meetings was last Wednesday, at Faraday House, 66, Southampton Row, W.C.

Parliamentary Party.—Endeavours will be made as soon as possible to arrange for the formation of a Parliamentary Party in the House of Commons to represent the electrical interests.

Co-operation with Existing Institutions.—The Committee are making every effort to work in co-operation with other existing associations and societies, and all questions which can be dealt with by other associations are referred to them, the Committee endeavouring to secure for each society the general support of the collective electrical industries.

Questions under Consideration.—The Committee have already had brought before them, and have under consideration, a large variety of matters, and it is felt that it will probably be necessary to make a selection of the more urgent or more important for their early attention. It would be a convenience to the Committee to receive notifications from time to time of matters which, in the opinion of any member of the industry, require to be dealt with, and it is suggested that any member of the industry, although not himself a member of the Committee, desiring any matter to be considered, shall communicate either with a member of the Committee or the honorary secretary, Mr. R. Borlase Matthews, Bank-buildings, Kingsway, W.C. Arrangements will be made to advise the electrical journals, as far as practicable, of any decisions come to by the Committee.

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Business Notes and News.

LIGHTING AND GENERAL—Home.

CLECKHEATON.—Out of a revenue of £4,720 the Corporation electricity undertaking made a net loss of £14 7s. during the past financial year. 774,220 units were generated and 668,812 sold at an average price of 1·60d. per unit.

COVENTRY.—A refuse destructor, by Messrs. Heenan & Froude, Ltd., capable of burning 135 tons per diem, has been set to work. The clinker is to be used to manufacture paving slabs, and the steam raised is to be utilised to generate electricity at the Corporation works 90 yards away.

LEEK.—The Corporation have decided that the price of current for lighting purposes shall be advanced ½d. per unit on all flat rates, and that the price charged to consumers on the maximum demand system be 7d. per unit for the first hour, and 3d. per unit afterwards; that in future all new consumers be required to guarantee a consumption bringing in a minimum revenue of £1 per half year before the service is laid.

LONDON: HAMMERSMITH.—The Borough Electricity Department received during the year ending March 31 £44,756 for current supplied to private consumers, £5,642 for public lighting, and £313 for meter rentals; and £2,720 for miscellaneous services. The expenditure amounted to £28,278, leaving a gross profit of £25,154. Out of this interest, redemption and bad debts accounted for £21,716, leaving a net profit of £3,482.

LONDON, ISLINGTON.—The Borough Council are going to put in a new main switchboard at their electricity works at an estimated cost of £3,000. The existing high tension feeder and low tension distributing mains being overloaded, it is proposed to construct and equip sub-stations for transforming the pressure. The cost of the proposed works was:—Highgate and Upper Holloway district, £5,708; King's Cross and Caledonian-road district, £2,313; Hornsey-road and Finsbury-park district, £2,957; Upper-street and City-road district, £8,894—total, £19,872.

NUNEATON.—Recently a very large fly-wheel burst at the Nuneaton works of Messrs. Fielding & Johnson (Leicester), and the firm called upon the Council's electric department to supply power to the extent of about 300 horse. The application was promptly dealt with by the Council's electrical engineer, and as a result the factory was not closed, a number of hands being kept on who otherwise would have been thrown out of work pending the completion of the repairs.

PAISLEY.—The Poorhouse is to be lit by electricity.

WORCESTER.—The Electricity Committee, in order to increase the use of electricity, are asking the Council to allow the Electricity Department to act as agents for manufacturers in the sale of heating and cooking apparatus and motors, on commission (but not to undertake the sale of fittings or lamps, or the wiring of houses), on the distinct understanding that the Council are not to be liable for the price of the goods sold.

LIGHTING AND GENERAL—Overseas.

COPENHAGEN.—It appears that large electrical works are at present being planned in Jutland, in the district between Aarhus and Randers. The scheme embraces not only an electric railway between these two points and the eventual establishment of branch lines, but also the supply of electricity to the whole district, for household as well as industrial purposes; while a scheme on much the same lines, including the establishment of a large central power station at or near Maribo, is proposed for Laaland and Falster.

ICELAND.—The British Vice-Consul at Reykjavik (Mr. A. Sigurdsson) reports that a company has been formed in Norway for the purpose of utilising the water power of the Gullfoss and Sog Falls, in Iceland. The company has obtained the right to make use of all the power of the Gullfoss and of part of that of the Sog Falls. The name and address of a gentleman who might be communicated with in the matter, forwarded by the Vice-Consul, may be obtained by British firms on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

LUCKNOW.—It is reported that the Mussoorie electric tramway scheme has been settled, and the construction will be taken in hand shortly.

ROME.—The Italian Minister of Posts and Telegraphs has brought forward a bill for the construction of a large number of new telephone lines for inter-communication between various towns and districts throughout Italy. The bill provides for a total expenditure of 740,000 lire (£29,600). A sum of 60,000 lire £2,400) is ear-marked for the purchase of apparatus and material required for carrying on experiments in multiple telephony and in combined telephony and telegraphy.

SARATOFF, RUSSIA.—H.M. Consul at Muscow (Mr. H. M. Grove) reports that the town of Saratoff is very largely inhabited by Germans. There is a great demand there for electrical material of all sorts. British firms desirous of doing business at Saratoff would do well to communicate in German, quoting in marks or roubles.

SIMLA.—The electric light installation on the Mall from the Club to the Library has been tried with success, the motive power being supplied by the United Service Club. This is only an experiment to ascertain the cost of lighting the station with electricity. An electrical licence has been granted to the Simla Municipality.

ST. PETERSBURG.—Nearly six million roubles are to be expended on telegraph and telephone construction and repairs within the Empire. Also over 38 million roubles on extension of State Railways, besdies over 26 million roubles on rolling stock and appurtenances.

WATERGRAAFSMEER, HOLLAND.—The communal authorities have decided to extend their electrical installations, for which purpose it is proposed to raise a loan of 35,000 gulden, about £2,917.

TRACTION—Home.

BELFAST.—A feature of the report issued by Mr. Andrew Nance, General Manager of the City Tramways, is the statement as regards the permanent way. This has had some five years hard wear, and although needing attention, it still serves well, and shows no bad joints. The expense per car mile run of permanent way repairs reached only ·17d., a decrease of ·03d. on the previous year. Considerable renewals, however, will have to be taken in hand shortly.

GLASGOW.—The Corporation Tramways report now out shows that the percentages of expenses to total receipts were:—Working expenses, 53·82; Corporation of Govan, ·54; Paisley District Tramways Company, ·50; interest on capital, 7·74; sinking fund, 9·11; Income-tax, 1·71; Parliamentary expenses, ·19; depreciation and permanent way renewals fund, 20·72—94·33, leaving a net balance of 5·67.

HULL.—The income from the City Tramways (overhead system) for the year amounted to £136,985 2s. 9d. The expenditure was as follows:—Working expenses, £86,098 4s.; interest, £13,775 14s. 3d.; loan repayment charges, £10,286 16s. 3d.; contributions towards cost of widening streets on tramway routes, £2,527 10s.; income-tax, £1,354 17s.; making a total expenditure of £114,043 1s. 6d. This left a surplus of £22,942 1s. 3d., and from which was deducted for relief of rates 1910–11 the sum of £16,000, leaving a sum of £6,942 1s. 3d. to be transferred to the reserve fund.

OTLEY.—The projected extension of the tramways from Leeds to Otley is likely to be abandoned. The total capital expenditure is estimated at £17,000, which would mean an annual outgoing of from £1,479 to £1,812, and this sum the Leeds Corporation expect Otley to guarantee. It is estimated that the total working expenses would amount to 5½d. per car mile, or £16 16s. 9d. per day, which requires 347 passengers at 3d. to cover working expenses.

TRACTION—Overseas.

VIENNA.—The Austrian Ministry of Railways granted to the communal authorities of Meran and Bozen a concession for the construction and working of an electric light railway in Meran.

COMPANIES' MEETINGS AND REPORTS.

PERTH ELECTRIC TRAMWAYS (WESTERN AUSTRALIA).

The report for 1909 states that the gross receipts for the year amounted to £74,649, while the profit amounted to £30,161. After payment of interest and sinking fund the balance at credit of profit and loss account is £12,456. To this has to be added the balance brought forward, making £13,556, from which has to be deducted £6,000 dividend paid on Preference capital. The directors, after repaying a loan of £4,000, recommend a dividend of 2½% on the Ordinary shares, place £4,000 to reserve, and carry forward £1,056.

RIO DE JANEIRO TRAM, LIGHT AND POWER.

The report states that the profit and loss statement for the year to December 31 shows that the net revenue from

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operation, after deduction of operating expenses, maintenance, taxes and other expenses in Rio de Janeiro was 3,438,494·78$, from which must be deducted the fixed and other charges of the subsidiary companies and the fixed charges and interest of this company, together amounting to 2,288,887·29$, leaving a net surplus of 1,149,607·49$. From this surplus a first dividend of 1% upon the paid-up capital, amounting to 311,908·54$ was paid on November 1, leaving a balance of 837,698·95$, which, being added to the surplus in 1908 of 870,236·66$, leaves an undistributed net profit of 1,707,935·61$.

CHILI TELEPHONE.

The report states that the gross revenue in Chile from all sources during the year to March 31, was 1,851,689$, an increase of 130,973$. The expenditure in Chile was 926,387$, an increase of 102,305$. The net income in Chili form all sources was 925,301$, an increase of 28,668$. Converted into sterling, the net income in Chile was £40,411, an increase of £2,713. The balance to credit of revenue account, including £2,820 brought from the previous year, is £41,091, of which £20,504 has been carried to reserve. An interim dividend of 3s. per share, free of income tax, was paid on January 15, and the directors now recommend a final dividend of 5s. per share, free of income tax, leaving a balance of £2,987 to be carried forward.

EGYPTIAN DELTA LIGHT RAILWAYS.

The directors state, in their report for the year ended March 31 last, that the coaching traffic shows a decrease. A total number of 7,132,090 passengers were carried, as against 7,639,324 carried during the year ended March 31, 1909. The gross receipts from this source were £162,560, being a decrease of £8,256, the average per mile per week being £5 1s. 8d., as compared with £5 8s. 5d. during the previous year. The quantity of goods lifted was 1,070,190 tons, as compared with 1,045,481 tons during the previous year, an increase of 24,709 tons. The gross receipts from this source showed a decrease of £8,877, being £76,236, as against £85,113 during the corresponding period. The decrease in receipts was in consequence of a relatively larger proportion of those classes of goods being moved which command the lowest rates of freight. Working expenses have been reduced by £9,911, being £154,315, as compared with £164,226 for the previous year. The ratio of expenses to gross earnings is only slightly higher at 62·70% for the year, against 62·28% for the previous year. The balance of the general reserve fund appears as £12,076, against £17,542 in the accounts of the previous year, the reduction being due to the defalcations referred to in the last report having been written off to this head. The net earnings for the year from all sources amounted to £91,815. This, with interest and dividends earned, amounting to £1,131, and £1,542 brought forward from 1909 (after payment of a final dividend of 2% on the preference shares, which absorbed £20,815), made a total of £94,490 to be dealt with. After providing for all fixed charges, interest on the debentures, and for the debenture and share capital redemption sinking funds, etc., a balance of £36,476 remained available for distribution. From this an interim dividend of 2% on the preference share capital was paid in December, 1909, the balance remaining being £15,660. The directors, after careful consideration, have decided that it would be advisable not to recommend any further distribution of profits for the year, but, instead, to husband the resources of the company. The balance of £15,660 will therefore be carried forward to the next year's account.

BOMBAY ELECTRIC SUPPLY AND TRAMWAYS.

The total revenue for the year 1909 from all sources, including the amount represented by sale of current to the tramways, amounted to £197,827, being an increase of £19,972, or 11·22%, as compared with the revenue for the previous year. The total expenditure amounted to £115,132, being an increase of £4,343, or 3·92%, compared with the previous year. The net receipts from the year's working of £82,695 compared with £67,066, the net receipts of the previous year, or an increase of 23·3%. After deducting the debenture interest, amounting to £30,530, there remains the sum of £52,165, to which is to be added the amount of £9,385 brought forward from last year, making an available total of £61,550. From this have to be deducted the dividend on the 6% cumulative preference shares, paid to August 15, 1909, £22,489; ditto accrued to December 31, 1909, £13,493; sinking fund for capital redemption, £6,000; leaving a balance of £19,567. The directors recommend that this sum should be applied as follows: To be placed to depreciation account, £15,000; to be carried forward to next account, £4,567. Of the sum of £15,000 to be placed to depreciation account the directors propose to invest the sum of £10,000 outside the business, being this year's provision for the ultimate replacement of that portion of the existing plant to which, in their opinion, an approximately definite life can be assigned. The traffic receipts derived from the working of the tramways amounted to £134,153, as compared with £126,098 for the previous year. The gross receipts of the electric supply for the year, including the amount represented by the sale of current to the tramways, amount to £57,552, as compared with £47,714 for the previous year. The working expenses amount to £40,934, as compared with £39,737 for the previous year. The balance of £16,618, as the result of the year's operations, compares with a balance of £7,976 for the previous year.

VICTORIA FALLS AND TRANSVAAL POWER.

The report of the Victoria Falls and Transvaal Power Company, Ltd., for 1910, to be submitted to the meeting on the 15th inst., states that during the year an issue of £900,000 Preference shares was made under a prospectus dated April 7, 1909, and at the date of the accounts the share capital was £2,708,000, divided into £1,000,000 of Ordinary shares of £1 each and £1,708,000 of 6% Cumulative Preference shares. During the year 1910 a further issue of £130,000 Preference shares has been made and the Debenture capital has been increased by a further issue, at 94%, of £900,000 5% First Mortgage Debentures, which issue was made to the Dresdner Bank and the Deutsche Bank. The total share and Debenture capital of the company, at the date of the report, stands at £4,538,000, made up as to £1,000,000 in Ordinary shares, £1,838,000 in 6% Cumulative Preference shares and £1,700,000 in 5% First Mortgage Debentures. The new issues of Preference shares and Debentures were made in connection with the provision of capital for the Rand Mines Power Supply Company, Ltd., referred to in the last report, and for the purchase and erection of additional plant for the supply of power to the groups of mines controlled by Messrs. S. Neumann & Company, the Consolidated Mines Selection Company, Ltd., and the General Mining and Finance Corporation, Ltd., with whom further contracts have been entered into. The year 1909 has again been mainly occupied by the work of construction, therefore no depreciation has been charged. In these circumstances a profit and loss account has not been included, but a revenue and expenditure account is incorporated in the balance-sheet, and shows a surplus for the year 1909 of £50,534, which, with the surplus brought forward from 1907 and 1908 of £84,863, making a total of £135,397, is carried forward to the year 1910. In consequence of the unexpectedly large and increasing demand of consumers, necessitating further expenditure for capital requirements, which ultimately will be met by increasing the Debenture debt, the directors have deemed it wise to carry forward the £135,397, and therefore no distribution of dividend upon the Preference shares will be made for the year 1909 before May next, when the new station at Rosherville will be in full operation. The demands of the mining industry for electrical power in the beginning of the year under review being in excess of the output from the new stations at Brakpan and Simmer Pan, it was considered advisable to continue the supply of certain consumers from the Driehoek station, taken over on the formation of the company. Owing to the design of this plant the cost of production was considerably higher than those at the new stations. The station at Simmer Pan has, however, been increased by the installation of two additional 3,600 kw. turbine sets, bringing the capacity of that station up to 27,400 h.p., which, together with the 9,700 h.p. at Brakpan new station, will enable the supply from the Driehoek station to be discontinued. The results obtained

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from the output of the Brakpan and Simmer Pan new stations have justified the estimates of the consulting engineers as regards coal consumption and cost of production. It is safe to assume that on the larger station at Rosherville a similar if not better result will be attained. The Rosherville station, as at present designed, will contain five 9,600 kw. turbine sets and four 4,000 h.p. steam-turbine driven air-compressors. It is expected that a partial supply will be able to be given from this plant about the end of the present year, and it will be working on full load about the middle of the year 1911. In addition to the above, the contracts already entered into by the company necessitate the erection of a further generating station, and the directors are proceeding at once with the preparatory work for the erection of a further power station at Vereeniging, in the terms of an agreement with Messrs. Lewis & Marks and the Vereeniging Estates, Ltd. Application has been made to the Transvaal Government, under the terms of the Power Act, 1910, to erect there a 53,600 h.p. station. It is anticipated that a license will be granted in due course. The extension of the transmission line between Simmer Pan station and the Roodepoort United Gold Mining Company, Ltd., has been completed and is in operation, and the material for the extension of the line from this point up to the West Rand Consolidated Mines, Ltd., has been shipped. This new transmission line is expected to be in operation in October next, and will be extended to supply the Randfontein Deep, Ltd. When completed the company's main distribution lines will extend from the West Rand Consolidated Mines, Ltd., on the west to the Cloverfield Mines, Ltd., on the east, a distance of about 45 miles. Additional contracts have been entered into for the supply of the power requirements of certain of the mines controlled by the General Mining & Finance Corporation, Ltd., Messrs. S. Neumann & Company, and the Consolidated Mines Selection Company, Ltd. Owing to the large expansion of mining activity within the Brakpan area (the extreme eastern portion of the Witwatersrand), the company is now proceeding with the erection of a large extension to the overhead network for the supply of the following mines in that neighbourhood, with which recent contracts have been concluded: Brakpan Mines, Cloverfield Mines, Geduld Proprietory Mines, Modderfontein B Gold Mines, Modderfontein Deep, Modder Leases, New Modderfontein Gold Mining Company, Rand Collieries, Spring Mines, and Van Ryn Deep. The total installed capacity of the new plant, when erected, will amount to 155,100 h.p., and, in addition, 16,000 h.p. steam-turbine driven air-compressors. This plant will enable the company to supply at the rate of 500,000,000 units of electric power per annum with proper provision for reserve plant. The directors are pleased to be able to report that the modified agreement with Messrs. Lewis & Marks and the Vereeniging Estates, Ltd., has been finally settled, and the document has been signed. Under its provisions, the company will purchase a proportion of its coal requirements from the Vereeniging Estates, Ltd. The price fixed, although satisfactory to the Vereeniging Estates, Ltd., compares favourably with supplies obtained from other producers.

COMPANIES REGISTERED.

HELSBY WIRELESS TELEGRAPH COMPANY.—Capital, £50,000, in £1 shares. Objects: To carry on the business of manufacturers of telegraphic, telephonic and electrical instruments and apparatus, etc., to acquire certain patents and inventions relating to wireless telegraphy and telephony, and to adopt an agreement with the Telegraph and Telephone Instruments, Ltd. The first directors are Lieut.-Colonel J. Bernard, 46, Ashley-gardens, S.W., and Captain C. M. Gonne, 9, Farnsham-mansions, Chelsea, S.W. Qualification, £200. Remuneration, £100 each per annum (chairman £150). Registered office, 25, Victoria-street, Westminster.

INTERNATIONAL "Z" ELECTRIC LAMP ASSOCIATION.—Capital £40,000. Manufacturers of incandescent lamps and other electrical apparatus, fittings and plant, etc. Agreements (1) with Compagnie Internationale des Lamps Electrique Zircone Wolfram Société Anonyme; (2) with the "Z" Electric Lamp Manufacturing Company, Ltd.; and (3) with Kilburn, Brown & Company. Minimum cash subscription, seven Preference shares. First directors (not less than three nor more than seven): A. Simson, A. Romberg, and W. L. Pakenham. £100. £40 each per annum (chairman £60). Offices: Orient House, New Broad-street, E.C.

NEW ELECTRICITY COMPANY OF MACCLESFIELD.—Capital, £5,000, in £1 shares. Objects: To carry on the business of an electric light and power company in all its branches. Minimum cash subscription, 250 shares. The first directors (to number not less than two nor more than seven) are to be appointed by the signatories. Qualification of first directors, 50 shares; of subsequent directors, 100 shares. Remuneration, £100 each per annum (chairman £150).

W. F. PEARE, LTD.—£10,000, in £1 shares. Business: That of an electrical engineer carried on by W. F. Peare. Private company. Office, 3, Catherine-stret, Waterford.

FINANCIAL NOTES.

CUBAN TELEPHONE COMPANY.—The following statement is being issued by the London Advisory Board of the Havana Telephone Company:—The July interest on the bonds of the Cuban Telephone Company will be paid by Messrs. Chaplin, Milne, Grenfell & Company, on July 1, against deposit of the provisional scrip. The difficulties which have delayed the completion of the recent bond issue of the Cuban Telephone Company have now been adjusted, and the issue is being proceeded with. Each bondholder who subscribed cash is given the right either to retain the bonds for which he subscribed or receive back his money. The validity of the concession held by the Cuban Telephone Company has been sustained by the Supreme Court of Cuba, and all questions which have been raised with reference to the statements contained in the prospectus have now been satisfactorily disposed of.

MANILA RAILROAD, LIGHTING & POWER.—Application has been made to the Committee of the London Stock Exchange for a quotation of the common stock of the Manila Electric Railroad and Lighting Corporation Co., which was recently introduced under good auspices at 60–62. The company was incorporated in 1903, and has an issued stock of $5,000,000, upon which dividends amounting to 3% were paid in 1906 and 1907, and 4% in 1908 and 1909.

MEXICAN LIGHT AND POWER.—The directors have declared a dividend of 1% on the ordinary shares, for the quarter ending June 30, 1910, payable July 15, 1910. The transfer books will be closed from July 11 to July 15, inclusive.

NATIONAL ELECTRIC SUPPLY.—The directors of the National Electric Supply Company, Ltd., have declared an interim dividend of 3s. per share, less income tax, on the Ordinary shares for the half-year to December 31.

NORTHAMPTON ELECTRIC LIGHT AND POWER.—In a circular dated 30th ult., the secretary of the Northampton Electric Light and Power Co., Ltd., points out that the Debentures are to be redeemed on January 1 next at par, namely, at the rate of £50 sterling for each Debenture of £50. The directors have resolved to issue, on or immediately after January 1 next, Debenture stock bearing interest at 4% per annum, and a trust deed relating thereto has been prepared, and will shortly be executed. The Debenture stock is at present limited to £50,000, but the company will be at liberty to issue further stock within the limits and upon the terms set forth in the trust deed. The stock will be redeemable at the rate of 105% pursuant to notice, or under certain contingencies mentioned in the deed, and any stock not previously redeemed will be redeemed at the same rate of 105% on January 1, 1936. In issuing this Debenture stock the directors will give the holders of the existing Mortgage Debentures the first opportunity of taking up the new stock at the rate of £50 stock for each Debenture of £50.

RIVER PLATE ELECTRICITY CO.—Notices have been sent to the shareholders of the River Plate Electricity Co., Ltd., of the conversion of 120,000 Ordinary shares of £1 each into £120,000 Ordinary stock, and of 100,000 Preference shares of £1 each into £100,000 6% Non-Cumulative Preference stock.

TRAMWAYS AND LIGHT RAILWAYS ESTATES.—For the year 1909 the accounts show a net profit of £5[illegible]7, out of which the directors recommend a dividend of 2½%, carrying forward £174.

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TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

Answer to Question No. 1,218 (*awarded* 10s.).

"Mica's" queries cover an enormous area, and within the limits of these columns no *complete* reply to them is possible; however, the following notes may remove some of the points of uncertainty referred to.

Quick Action:—The rate of current growth (direct current) in an inductive circuit is given by

$$C_t = \frac{E}{R}\left(1 - e^{\frac{-R_t}{L}}\right) \quad \text{where}$$

C_t = current (amps) t secs. after closing the circuit. E = applied volts, and R and L = resistance and inductance respectively of the circuit.

Assume for illustration that R = 110 ohms: L = 55 henries E = 110 volts, then

$C = (1 - e^{2t})$ amps, which gives

t	C	t	C	t	C
·01 sec.	·0193 amp.	·2 sec.	·3297 amp.	2·0	·9817
·05 ,,	·0952 ,,	·5 ,,	·6321 ,,	5·0	·9990
·10 ,,	·1813 ,,	1·0 ,,	·8647 ,,	∞	1·009

data which are plotted in Fig. 1, which also shows the current decrease on disconnecting the above magnet $\left(C \text{ then } = \frac{E}{R} \cdot e^{\frac{-R_t}{L}}\right)$. The time constant of the above magnet (= time required for current to reach $\frac{e-1}{e} \times$ final value) = ½ sec.

For a *very* short interval after closing the magnet circuit $C \propto \frac{E\,t}{L}$ *i.e.*, L has the effect of a resistance for the time being.

To reduce the time constant of the winding and so smarten its action, L must clearly be kept a minimum and R made a maximum. Laminating the magnet core increases L, and hence causes more sluggish action. Both the inductance and resistance of a magnet coil of given volume vary with $(n)^2$ (where n = nv. of turns). It is, therefore, impossible to improve the smartness of action by rewinding, except in so far as the time constant of the whole circuit, including line, is reduced by increasing the magnet coil resistance.

Where smartness of action is desired it is better to parallel magnet coils rather than connect them in series (the latter connection gives 4 × inductance with only twice the magnet effect). The time taken by the current to reach any desired magnitude is given by

$$t = \frac{L}{R}\log_e\left(\frac{1}{1 - \frac{CR}{E}}\right)$$

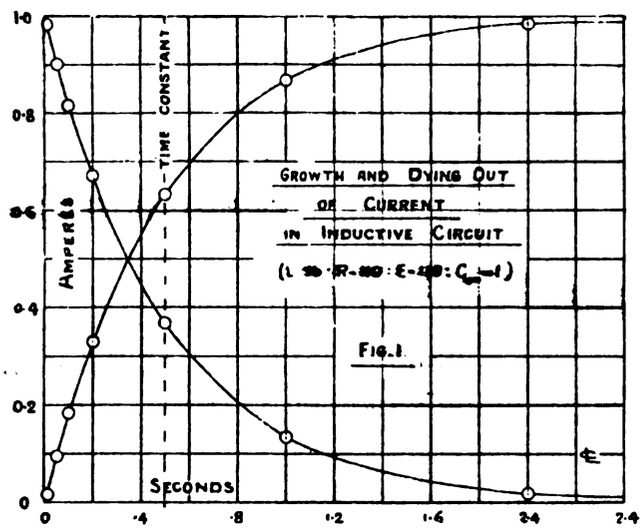
showing that for quick action E should be as high as possible. The ultimate pull of course ∝ ampere turns and, therefore, requires a large value of C. A long air path and short iron path favours rapid demagnetisation: the rate of current decrease in a coil encircling a closed iron circuit is very slow.

Spark Prevention.—On opening the circuit of an inductive coil, energy = ½ LC^2 joules, hitherto stored in the magnetic field, is released. This energy is dissipated in some or all of the three following ways:—

(*a*) The collapsing lines of force cut a closed copper sheath placed round the coil and generate eddy current therein, the total energy (½ LC^2) being thus rapidly dissipated as heat. The copper sheath may be supplemented or replaced by layers of foil between each layer of the coil winding, but such a construction is liable to breakdowns.

(*b*) The collapsing field may generate an E.M.F. in the metal of the magnet winding. This E.M.F. then causes a spark or arc at the point of rupture of the circuit, the returned energy being thus dissipated.

(*c*) If the rupture be so sudden and complete as to allow of no appreciable sparking, the above E.M.F. causes current surges along the winding, the energy being thus dissipated partly as heat and partly in straining the coil insulation.

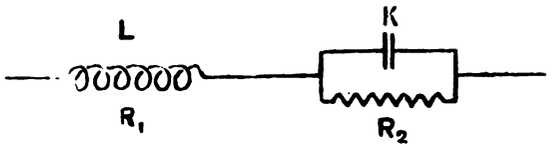


The use of a sheath as in (a) largely prevents sparking, while two absolute means of prevention, often applicable to D.C. circuits, are:

(1) "Short circuit" working: Instead of *breaking* the magnet circuit the coil is short circuited a discharge path being thus provided for the inductance surges.

(2) "Differential" working: A second coil of equal but opposite ampere turns to the first is wound on the same core. When it is desired to abolish the effect of the normally used coil the second winding is also switched into circuit. The nett magnetic effect is then *nil*, and the pair of windings form a practically non-inductive circuit.

Serious sparking only occurs on *opening* an inductive circuit: the available inductive E.M.F. ∝ inductance of the circuit and the rapidity of opening it. Minimum sparking is, therefore, obtained by reducing the actual L (henries) or by reducing the equivalent inductance of



the circuit as a whole. The latter may be effected by the use of series or parallel resistance or by parallel condensers. Slow opening of the circuit is effected by gradually introducing series resistance before completing the rupture; parallel resistance and condensers are chiefly valuable as providing a discharge path for the inductive surges.

A quick break, though increasing the E.M.F. induced by the collapse of the field, and so increasing the stress on the insulation, limits the damage caused by the spark itself. Platinum resists oxidation and melting by the spark, but it is too costly for large contacts; carbon "breaking" tips are now usual in the latter instances; a rubbing contact is preferable to a tapping action.

A quick break may be secured by a smart switch opening (by spring or otherwise), by immersing the "break" in water or alcohol, etc. (hydrocarbons deposit soot and clog the contacts; they must, therefore, not be used), by the use of automatic slate or fibre "shutters"—mechanically breaking any spark, by the use of magnetic blow-outs, or

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by the use of air blasts, or by a combination of any of the above means.

Use of Shunts.—(*a*) The coil may be shunted by a non-inductive resistance R (usually put in and out of circuit by the switch movements). If the P.D. to which R will be subject $\propto$ V volts and normal current capacity = C, then $R = \frac{V}{C}$ ohms. (*b*) The "break" may be shunted by a condenser, in which case, the capacity of the terminals being increased, the sparking voltage is reduced. Sparking, though reduced, still occurs so long as $K = \frac{4L}{R^2}$.

If the coil be shunted by a condenser parallel resonance may be set up, though, owing to the comparatively high R of the winding, it is not likely that dangerous amplitudes will be reached. (*c*) Resistance and capacity may be used together (see Fig. 2) as shown, or both in shunt to the coil. In Fig. 2 the necessary condition is: $KR_1R_2 = L$. (*d*) Small accumulators (opposing the inductive kick) or liquid resistances may be used to shunt the "break."

Multiple Wires.—By using from four to twenty conductors, wound in one layer each, and in the same sense, all the wires are paralleled, their total current capacity being equal to that of the single wire ordinarily used. The heating of the sub-divided coil is slightly higher, but the inductive "kick" is spread out (as to duration) and reduced in magnitude owing to the L of the outer layers being less and the R greater, so that the "kicks" of no two members of the parallelled group coincide.—"L.C."

NEW SELF-STARTING INDUCTION MOTOR.

The Electric Construction Company, Ltd., have been experimenting for some time past with a new type of three-phase motor, the principal points of which are the absence of brushes, slip rings, rotor cables or outside starter; it has all the well-known good characteristics of the wound rotor type without its drawbacks. The peculiar features of this new machine (designed and patented by N. Pensabene-Perez) are the method of fixing the resistances to the rotor, and the arrangement for cutting them out while the machine goes up in speed at starting. When the machine works at full speed there are no rubbing contacts whatever, so no lifting or short circuiting plugs or similar complicated arrangements are necessary. The revolving resistances are very compact, and of very strong mechanical construction, are totally enclosed in a cast-iron case, and they are cut out, either by hand or automatically. A very important feature of the machine is that, being started through a large number of steps (from 20 to 30 per phase), there is no jumping of the current at starting, but it gradually varies by small steps from the starting to the running value. The automatic type, considering the simplicity of its construction, is an important step forward in the development of induction motors. A long distance control, as found necessary in the many applications of electrical drive, is thus accomplished at very little expense, and with the most reliable means by the simple operation of closing the stator main switch. The automatic type being controlled by the speed lends itself to a simple solution of the problem of preventing a rush of current during the starting period. In fact, by a rational choice of spring-tension, frictional resistance, and value of centrifugal forces, it is possible to keep the current approximately constant while the machine is speeding up, thus accomplishing what many complicated devices, in the case of hand control, are supposed to do. This motor is less expensive than the ordinary slip ring type, moreover, no starter or rotor cables being necessary, it is evident that even from an economical point of view the machine must prove a success. Everything, therefore, points to a big future for this very ingenious and practical machine.

INTERNATIONAL RAILWAY CONGRESS.

At the opening of the International Railway Congress, which took place at Berne on Monday, under the honorary presidency of M. Forrer, Chief of the Swiss Railway Department, M. Weissenbach, acting president, in speaking of the importance of the Swiss lines, said that electric traction, which was already in operation on the secondary lines and for the traffic through the Simplon, would be extended to the main international routes.

BRAY ELECTRIC LIGHT.

Mr. W. J. U. Sowter, electrical engineer, has issued a report to the chairman and members of the Electric Light Committee of Bray, suggesting a new method of charging consumers. The scale he proposes is as follows:—

(a) Residences, private hotels, boarding houses, public institutions and churches, hotels only partially lighted by electricity, hotels open only during the summer months, shops closing at or before 8 p.m. five nights per week, 6d. per unit;

(b) Shops with licensed premises attached and a portion open until 11 p.m. throughout the week, railway and all outside arc lighting where separate meters are fixed, 5d. per unit;

(c) Clubs lighted throughout by electricity, licensed hotels open throughout the year, and public houses lighted entirely by electricity, 4½d. per unit; and

(d) General flat rate for all classes not in the foregoing list, 6d. per unit.

In addition to the preceding, Mr. Sowter thinks that the Committee should give attention to the cultivation of a day load. At present, he points out, the works are entirely shut down during the noonday light, and, apart from the boon a day supply would be to existing consumers, he believes that in course of time a substantial addition will be made to the revenue by giving a cheap supply for heating, cooking power, etc. This matter, it is pointed out in the report, is of extreme importance, because, owing to the introduction of the new lamp, the prospective revenue for lighting purposes is very much less than formerly. Mr. Sowter therefore suggests to the Committee the desirability of giving a continuous supply from October 1 to March 31, and recommends that a scale of charges be introduced for electricity used for industrial purposes, heating and cooking—(1) for the first 200 units per quarter, 3d. per unit; and (2) all in excess of the above, 1½d. per unit. Separate meters for this class of supply to be installed at a rental of 1s. per quarter.

STOKE-ON-TRENT.

There has been some fun over electrical matters in connection with the Potteries Federation. It is evident that at no distant date a considerable sum of money will be spent on linking up the various borough electricity works. Meanwhile, Councillors of the several towns have been taking sides in defence of their own works and systems. Hanley is in the unfortunate position of possessing a single-phase A.C. system, but although this is not ideal, very good results have been obtained with it. One of the local scribes set out to explain to the electorate that as a single-phase A.C. motor cannot be started against full load, the system was unsuited for power purposes, thus ignoring the mechanical devices for overcoming the drawback. As a matter of fact, Hanley, with its 100 cycle, single-phase A.C. system, had motors to the amount of 1,077 h.p. connected in February, while Burslem, with its D.C. system, had only 1,033 h.p. in April, and Stoke 1,057. This speaks well for the management, which has made the best of what it had got. The same critic, arguing on the fact that a little over a quarter of a million units of the total generated were unaccounted for, works out an alarming calculation on the basis that the units sold cost 2·4d. to produce, quite unconscious that the total cost of production is charged against the units sold. No doubt the system in use does entail a loss above the average, but it is absurd to put forward such misleading calculations.

THE NEW PALACE STEAMERS.

A new departure has been made this summer by the New Palace Steamers, Limited. Hitherto Friday has been an "off-day" for this company's admirably appointed vessels, but from now onwards there will be a daily service to Margate and Ramsgate by the "Royal Sovereign" and a service to Southend, Margate, Ramsgate, Deal and Dover by the "Koh-i-Noor" every Monday, Wednesday and Thursday. An excellent lunch can be obtained on board during the outward journey, and on the return voyage passengers can dine in comfort in the handsome and well-appointed saloons.

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PATENTS.

Electric Supply Systems.

12450—1909. R. HERZFELD, London, E.C. The object is to utilise a part of the calorific value of fuel used in obtaining hot water for domestic purposes, to generate electricity. A high-pressure steam boiler is used instead of the ordinary low-pressure boiler. The high-pressure steam, before it is used in the hot water calorifer is employed to drive an electricity generating plant, operating with accumulators whereby sufficient electricity is gained as a bye product of the domestic hot water plant to provide for domestic lighting, cooking and heating by electricity.

Lanterns for Electric Lamps.

12808—1909. H. WARDLE, Manchester. The casing of the lantern above the globe is cut through to form an announcement for advertisement. The light in the interior of the casing is emitted from lamps below a disc and thrown upward by means of reflectors.

Electric Power Traction Systems.

12937—1909. R. J. HOUGHTON, P. ALLMAN AND W. T. GRAY, Liverpool. In an electric power traction system in which the track is provided with separate positive and return conductors electrically independent of the track rail, the two conductors are supported by insulating blocks which are bolted to a central supporting element consisting of short vertical plates. The plates are bolted into chairs disposed at intervals along the track.

Sheathing Insulated Electric Conductors.

13220—1909. SIEMENS BROS. & Co., Westminster, S.W. The sheathing is composed partly of soft and partly of hard metal. The hard metal serves to prevent the soft metal from buckling.

Ploughs for Electric Tram Cars.

13238—1909. G. LAURIE WALKER, London, E.C. The plough comprises a neck portion furnished with a vertically movable bar provided at its lower end with laterally extending arms, and a body portion provided with contact shoes and furnished with brackets with which the arms engage to support the body portion. Disengagement of the arms from the body unships the body portion of the plough and permits the neck portion to be withdrawn from the conduit.

Electric Furnaces.

13295—1909. DR. H. NATHUSIS, Berlin. The electrodes in the furnace are connected to successive poles in the generator and are arranged all round the smelting bath and connected to the source of current in circuit so that they receive the whole of the current in circuit, owing to the opposite ends of the separate phases of the generator being connected to opposite electrodes in the bath.

Electric Switches and Switch Fuses.

13442—1909. H. H. BERRY, London, E.C. This is an improvement in armour clad switches of the kind in which a hinged cover is employed, adapted to be moved backwards and forwards and to carry the switch mechanism. In order to strengthen the make and break action of the switch, pivoted arms in combination with springs are employed in the place of the band spring.

Driving Mechanism for Petrol Electric Apparatus.

15282—1909. FELTEN & GUILLEAUME-LAHMEYER WERKE, A.G., Frankfort a-Main. The invention consists in the combination with a driving device, having a dynamo coupled to a heat engine and to one of two driving wheels, and having an electromotor fed with current from the dynamo and driving the other wheel, of a coupling device that can be thrown in and out of gear arranged between the rotatable parts of the dynamo and of the electric motor for the purpose of disconnecting the electric transmission device.

Electricity Meters.

15438—1909. G. HOOKHAM, Birmingham. The meter has an armature immersed in mercury with separate compensating poles provided with magnetic projections which extend towards the permanent magnet.

Filling Electric Joint Boxes.

20105—1909. C. J. BEAVER AND E. A. CLAREMONT, Hale. A funnel fills the opening through which the box is filled. The box is filled with heated liquid through the funnel which is left in position with a portion of the liquid remaining in the funnel. As the gases which form in the box rise and percolate through the compound, that which is in the funnel drops to fill up the space left void by the gases.

Electrical Transformers.

23938—1909. C. LE GEYT FORTESCUE, Wilkinsburg, U.S.A. In this laminated transformer which is composed of a number of L-shaped plates, having those parts which are disposed within the transformer coils reduced in cross sectional area, the plates are formed and arranged in such a manner that no air gaps between parts of the lamina will occur within the reduced cross sections of the core.

Electrical Switches.

25156—1909. S. EVERED, Smethwick. The improved means for locking the brush in either its on or off position consists of a pair of yoke-like jointed arms having a spring tending to reduce the angular shape between them. One of the arms serves by its engagement with one of two notches near the end of the pivoted contact arm of the brush, to lock the brush in its on position. The other yoke arm serves by its engagement with the other notch, to lock the blade in its off position.

Electric Resistances.

26929—1909. DR. H. KÖRBER, Waldegg. This process for the manufacture of electric resistances consists in producing a metal glass compound composed of metal and water glass with the addition of an oxygen compound of manganese and of aluminium. The metal glass is pulverised, converted into a plastic mass, with a binding medium, and pressed into moulds. The resistance body is finished by heating, or by an electric process whereby resistance bodies are obtained which are capable of being permanently exposed to a high temperature.

Telegraph Transmitters.

27101—1909. G. M. GODDARD, A. C. GROVES, AND G. C. THRALL, Rutland, U.S.A. In this transmitter a key lever, having an electrical contact, co-operates with a cam having transmitting characters and mounted on a shaft which has a longitudinally extending clutch groove. A clutch member disposed within the cam enters the groove.

Electrical Ignition Apparatus for Internal Combustion Engines.

3247—1910. B. BROOKS, AND F. H. ALSTON, Birmingham. In this electric ignition apparatus ball or roller bearing contacts are employed comprising a ring of balls contained within a cup adapted to be engaged by a relatively rotating spring influenced feeder brush. The cup is carried by a stem which passes through the part on which the contact is mounted and constitutes an external terminal.

Electric Switches.

3927—1910. A. P., G. C., AND P. A. LUNDBERG, London, N. The lower part of the push button has an inclined surface. Between the push button and the movable contact making member there is a pivotally mounted bell crank lever which is under spring action and connected at the end of one of its arms with the contact making member, while at the end of the other arm it carries a roller which bears on the inclined surface of the button.

Telephone Transmitter.

4446—1910. F. GOTTSCHALK, New York. The casing has an apertured front wall. The diaphragm in the casing comprizes a forwardly flaring cup-shaped shell connected centrally to the diaphragm and provided with a flange at its outer edge which has an overlapping relation to the margin of the aperture.

Mast for Wireless Telegraph Apparatus.

7082—1910. A. F. JUILLAC, Paris. This collapsible mast which serves as a support for the antennae in wireless telegraphic apparatus and for analogous uses, consists of a number of telescopic tubular lengths, each capable of being hoisted vertically to the summit of the preceding length by means of pawl mechanism. The upper extremities of each tube can be tightened by means of a collar and wire arrangement.

PERSONAL.

Mr. C. H. Yeaman has been appointed chief electrical engineer and manager of the destructor works of the county borough of Stoke-on-Trent, at a salary of £500, plus £10 for travelling expenses.

When increasing the salary of Mr. Johnston, general manager of the Gloucester City Tramways, to £350, the Mayor stated that in the five years of Mr. Johnston's managership the operating expenses had been reduced till now they were the lowest of any municipal tramway undertaking in the kingdom, that the gross profits had considerably increased, and the tramway rate reduced from 5½d. in the £ to 3½d.

Mr. C. G. Habgood, of Bristol, has succeeded Mr. George Garratt as junior shift engineer at the Wednesbury Corporation Electricity Works.

Mr. John Wood, jun., has joined the firm of Mosses & Mitchell, vulcanised fibre manufacturers, of Golden-lane, London, E.C.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year.							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	June 29	1,370	1,338	+ 32	+ 135	27½	27½	May 31	71,980	17,517,304	1,566,119	·98	11·02	4,940,	3·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	June 26	1,154	1,017	+ 137	+ 227	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	June 25	6,814	6,481	+ 333	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	—1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams.	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	June 25	5,317	4,742	+ 575	+1,221	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	July 3	963	1,023	— 60	— 504	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	July 1	6,127	5,876	+ 251	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	July 2	1,264	1,345	— 81	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	June 26	267	297	— 30	— 44	6½	6½	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	June 25	5,870	5,861	+ 9	+2,588	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6 822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	June 26	3,078	3,327	— 249	— 723	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 19	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	June 30	545	537	+ 8	+1,745	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	June 17	1,781	1,457	— 324	+1,844	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	June 30	141	115	+ 26	+ 72	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	July 1	6,122	5,834	+ 288	+ 5,203	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	July 2	1,032	987	+ 45	+ 324	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	June 25	18,848	17,385	+1,463	+ 5,523	194½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	— 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·18	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	July 2	2,797	2,562	+ 235	+ 2,261	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	June 30	130	140	— 10	— 83	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 5	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	June 22	1,452	1,295	+ 157	+ 306	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	June 26	1,521	1,419	+ 102	+ 785	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	June 18	43,535	36,655	+6,880	+ 67,775	132½	118½	Mar. 31	1,274,660	279 166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+ 57	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	July 2	11,904	10,289	+1,615	+25,781	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	June 26	17,928	17,701	+ 227	+ 13,400	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	June 25	6,704	6,052	+ 652	— 769	60½	59½	„ 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,096	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	June 26	6,029	5,691	+ 338	+ 4,378	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	June 15	1,128	1,035	+ 93	+ 376	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	June 22	154	127	+ 27	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	June 25	984	920	+ 64	— 420	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	June 23	2,759	2,460	+ 299	+ 917	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,669	975,714	—	10·929	2,190	6·509

a Train Miles. A Half-year's figures.

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NOTES.

Committee Competition.

Manchester is setting a good example in the matter of competition between the Electricity and Gas Committees. In the desire to run municipal commercial undertakings on commercial lines rivalry is often carried to absurd extremes, to the detriment of each concern and the community as a whole. To avoid this the Manchester Electricity and Gas Committees are meeting to discuss affairs. According to Alderman Walker, good has already come of this. For, he said, when speaking before the Council, as a preliminary to the Conference the officials had met and cleared a good deal of ground. For example, they had disposed of the notion that the Electricity Committee supplied current for power purposes at a loss. The Committee never did that. That such a coming together is necessary is proved by the remarks of Mr. Alderman Gibson (chairman of the Gas Committee), who, at the same meeting of the Council, explained that the Gas Committee declined on economic grounds to put gas stoves only in houses that were provided with the electric light. The Committee accordingly stipulated that if gas stoves and cookers were put in there must be at least one gas light in the kitchens provided. As to the conference, it was quite true one was about to be held. His wish was that the two committees should work together as brothers, not as antagonists, and that they should remember it was the ratepayers' money they were using.

National Physical Laboratory.

Members of the Physical Society of London recently visited the National Physical Laboratory, Bushey Park, Teddington, and witnessed a special series of demonstrations. A very important series of researches are at present being carried out in the electricity department. Mr. Paterson is in charge of experiments to reproduce the unit of candle power in light of a whiter tint than that yielded by existing flame standards, an improvement rendered imperative in photometry by the introduction of the metallic filament lamps. Good progress is being made. Meanwhile both Mr. Paterson and Mr. Rayner are busy in making tests for the Engineering Standards Committee on the ageing and weakening of dielectrics and the measurement of dielectric losses at high voltages. The arrangements for an investigation undertaken for the Wiring Rules Committee of the Institution of Electrical Engineers, to determine the temperature rise, with normal and other current densities, of cables with various types of covering, were shown by Mr. Melsom. The tests actually in progress were of 7/16 cables, one cable being drawn into iron tubing and embedded in plaster, and another drawn into iron tubing without any further covering. The temperature of the cable is determined by measuring the change in resistance of the conductor by a Kelvin Double Bridge. Arrangements were also shown for determining the insulation resistance of the cable and the temperature coefficient of the conductor. All this is invaluable work for the ultimate progress of the industry.

Wireless Progress.

The progress, achieved and prospective, of radio-active telegraphy is very marked. From the Antipodes we hear that the Commonwealth Government of Australia have decided to adapt the recommendation of the Conference of the British Admiralty, Australia, New Zealand and Fiji representatives to link up all the British islands in the Pacific by wireless telegraphy. To this end high power stations will be erected at Sydney, Doubtless Bay (New Zealand), Suva and Ocean Island, with smaller power stations in the New Hebrides and the Solomon Islands. At home, Sir Edward Sassoon, M.P., proposes to introduce this Session a Bill to make it compulsory for all vessels carrying passengers to be fitted with wireless telegraphic apparatus.

University Research.

Radio-telegraphic research work has caught the fancy of London University, and both at University College, Gower Street, and King's College, Strand, elaborate wireless equipments have been installed, the two colleges being also in uninterrupted communication, so that study and research can embrace theory and practice. At University College the antenna consists of a fan aerial of four double copper wires, rising along the outer wall of the south wing to some 50 feet, and then stretching horizontally across to the Physiological Institute, to which it is attached. The length of the radiated waves is about 1,450 feet, so as not to interfere with the International Convention wave length, and to enable the waves to overcome the obstruction of buildings without too much loss. Various types of appliances are used for despatching and receiving, so that all kinds of tests may be made. One of the points at present receiving special attention is the energy loss in condensers. Post-graduate courses are being given by Professor Fleming at University, and Professor Wilson at King's.

Municipalities and Contractors.

The fluttering in the dovecotes caused by the Leicester judgment has by no means abated. In many quarters where one would hardly expect to find such ignorance, the opinion seems to prevail that the decision in the Leicester Corporation cases makes it impossible for any municipal concern to do aught else than sell current. There appears, indeed, to be an attempt to create a scare even in such boroughs where a special clause in the Act of Parliament makes trading lawful. A case in point has occurred at Kingston-on-Thames. But, as Mr. J. E. Edgcum points out, the borough electricity department's system of deferred payment for wiring could quite legitimately be carried out by the Corporation. As a matter of fact, what is actually done is for the Electricity Department to prepare detailed specifications for each installation and let it by open tender. This answers admirably, everybody being content. It is well to observe that the interests of the Corporation and the consumers are protected by the very fact that the Electricity Department possesses the power to undertake the work direct. This *modus vivendi* is certainly to be recommended wherever it is possible.

The Panama Canal.

Mr. W. H. Magee, in an interesting contribution to the "Daily Telegraph," speaks enthusiastically of the progress being made with the Panama Canal. A point often overlooked is that electricity is to play a very big part in the canal administration, as it has, indeed, done in the work of construction. No vessel will either enter or pass through the locks under its own power. In order to secure smooth running and the least disturbance electrical towage will prevail. Lock gates, valves, capstans, and so on, will also be operated by electricity, which will be generated by water turbines, an excellent head of water being obtained from Gatun Lake.

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Ferro-Concrete.

We are daily becoming accustomed to the increasing use of armoured concrete in the building of central or sub-station structures, the provision of heavy machinery foundations, and so on, but at the Tramways Conference recently held in Dublin, Mr. P. S. Sheardown, electrical engineer, Dublin United Tramways Company, drew attention to a comparatively new use of this method of construction. At the Ringsend generating station of the company two steel chimneys, each 200 feet above their brick bases, had been erected. These were lined with brick, but this lining was a few inches away from the outer casing. Notwithstanding this protection, corrosion had become very extensive from the inside, the structure being endangered. Ultimately it was decided to build a ferro-concrete lining, inside the brick lining (which reduced the diameter of the chimney to 9 feet). The top twenty feet of the brick lining was removed and the ferro-concrete lining was for this length bonded with the steel shell. The concrete consisted of one part of cement and three of fine sand. The reinforcement comprised vertical steel tee bars 1¼in. × 1¼in. × 3-16ths in., and horizontal 5-8ths. in. round steel bars. The vertical bars numbered 300 at the base, diminishing every 18 inches, where the horizontal ties occurred, until at the top only 12 were required. The work was carried out expeditiously, and apparently has answered very well. Mr. Sheardown was inclined to advocate ferro-concrete wherever new chimneys had to be erected. They are certainly economical, and do not take long to erect.

TRAMWAYS AND LIGHT RAILWAYS LAID ON PUBLIC ROADS.

The following memorandum regarding details of construction and equipment of tramways and light railways on public roads, dated April, has been issued by the Board of Trade. It is to be noted that these requirements and recommendations apply only to matters undertaken after the date of the Memorandum :—

(1) Clearance.

(*a*) The space between the inner rails of a double line must depend upon the overhang of the cars. It is, however, necessary that there should be at least 15 in. between the sides of the passing cars and also a similar space between the side of a car and any standing work such as lamp, telegraph and trolley wire posts in a street.

(*b*) The bases of side posts should be placed inside the kerb at a sufficient distance from it to prevent the possibility of road vehicles coming into contact with them.

(*c*) There should be at least 15 in. between the side of a car and the kerb, whether on straight or curved roads.

(*d*) The clearance between the top deck of cars and the under-side of bridges should not, if possible, be less than 6 ft. 6 in. Where this clearance cannot be obtained special precautions in working will be required, but in no case will less than 6 ft. be accepted with uncovered cars.

(2) Posts and Brackets.

(*a*) Centre posts should not be used without the consent, in every case, of the Board of Trade.

(*b*) The stone kerbing round centre posts should not be such as to enable any person to stand upon it as a refuge, unless the clearance is ample for safety.

(*c*) Where bracket arms 16 ft. in length will not suffice, it is desirable that span wire construction should be used.

(*d*) The overhead conductors used in connexion with the working of the tramways should be securely attached to supports, the intervals between which should not, except with the approval of the Board of Trade, exceed 120 ft., and the overhead conductors should be in no part at a less height from the surface of the street than 20 ft., except where they pass under bridges.

(*e*) The overhead conductors should be divided up into sections no exceeding (except with the special approval of the Board of Trade) one-half of a mile in length, between every two of which should be inserted an emergency switch so enclosed as to be inaccessible to pedestrians.

(*f*) Poles supporting gas lamp brackets should be efficiently bonded to the rails.

(3) Permanent Way.

(*a*) The weight of rails should not be less than 90 lbs. per yard, 100 lbs. being preferred.

(*b*) The groove of the rail should not exceed one and an eighth inch in width, but a groove not exceeding one and a quarter inch will be accepted on curves of less than 150 ft. radius.

(*c*) The details of permanent way and mode of construction as approved by the Board of Trade should not be varied at any time without the Board's consent.

(4) Cars.

(*a*) Drawings of the cars intended to be used on a line should be submitted to the Board of Trade for approval, before orders for the cars are placed.

(*b*) Staircases of the "reversed" type should be avoided, more especially on lines of less than 4 ft. 8½ in. gauge.

(*c*) Of existing types the "trigger" lifeguard is the pattern which is preferred. The hanging gate should be as close to the ground as possible, and there should be at least three feet between it and the front of the guard. Both the guard and the gate should be at least as wide as the outside of the frame of the truck. The tray of the guard should be provided with a spring so as to hold the front edge down to the surface of the roadway when the tray is dropped.

(*d*) In order not to interfere with the efficiency of the lifeguard it is desirable that folding steps should be adopted on all new cars.

(*e*) On lines having severe gradients and sharp curves, the use of double-deck cars may be objected to.

(*f*) Where the gauge of the line is 3 ft. 6 in. or less, top deck covers should not be used without first communicating with the Board of Trade to enable the circumstances of each such case to be specially considered.

(*g*) Arrangements for sanding each rail should be provided at each end of the cars.

(*h*) Top deck railings should be at least 3 ft. 6 in. high.

(*i*) All railings should be connected with earth.

(*j*) All electrical conductors fixed upon the cars in connexion with the trolley wheel should be formed of flexible cables protected by india-rubber insulation of the highest quality, and additionally protected wherever they are adjacent to any metal so as to avoid risk of the metal becoming charged.

(*k*) The trolley standard of every double-deck car should be electrically connected to the wheels of the car in such manner as either to prevent the possibility of the standard becoming electrically charged from any defect in the conductors contained within it or in the event of the standard becoming electrically charged to give a distinctive and continuous warning signal to the driver or conductor. The signal may be a red lamp bridged with a suitable fuse or (preferably) an audible signal. The signal device should be tested at least once a week. (This requirement will not apply to the trolley base on the top cover of double-deck cars.)

(*l*) An emergency cut-off switch should be provided and fixed so as to be conveniently reached by the driver in case of any failure of action of the controller switch.

(*m*) Where trolley ropes cannot be dispensed with or tied up, precautions must be taken to prevent the "slack" causing accidents.

(*n*) To prevent trolley booms being pulled out or trolley standards broken, "traps" should be minimised and detachable trolley heads provided. A catch rope should be attached to prevent the trolley head from falling.

(*o*) No material alterations should be made in cars after inspection, nor any fresh type of car adopted, without the consent of the Board of Trade.

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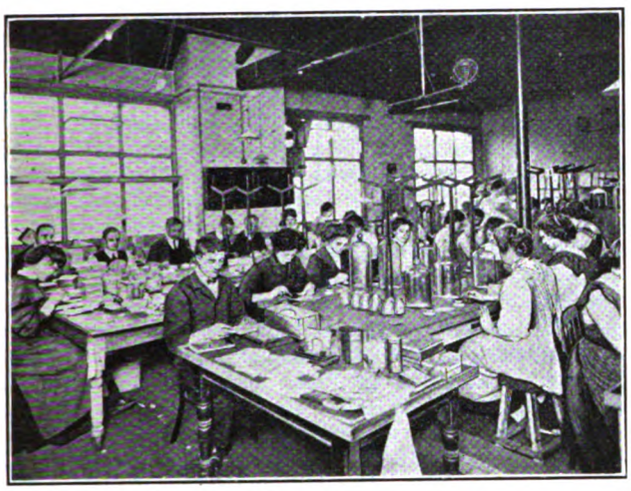
"British Metalite."

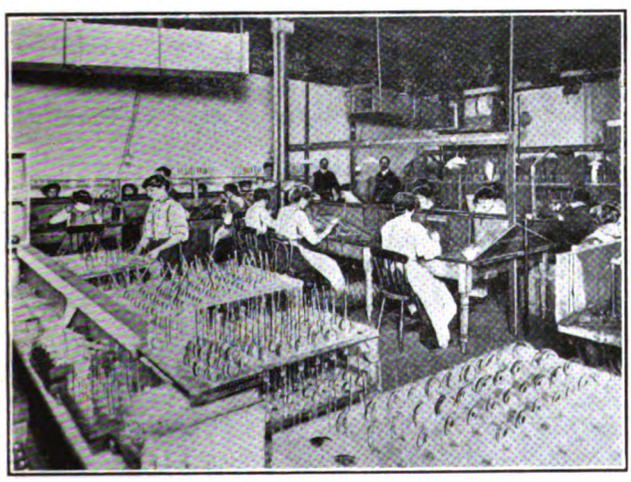
Probably one of the most inspiring examples of British inventive genius and business enterprise of recent years is afforded by the "Metalite" electric light filament industry. Faced by great technical difficulties, financial drawbacks, and the keenest competition from heavily-supported foreign experts of unquestioned merits, the inventor of the "Metalite" filament struggled on against adverse circumstances, until he interested the Bryant Trading Syndicate. The group of men forming that organisation were quick to appreciate the great possibilities of the invention offered to



Corner of Laboratory.

them, imperfectly developed though it was when it came before them two years ago. Confident of ultimate success, all turned to with a will, and after much hard work and the expenditure of large sums of money, something which may well claim to be an ideal incandescent metallic filament for electric lights was produced, and, in due course, introduced on the market.

The special points of the newcomer were speedily recognised, and although the Bryant Trading Syndicate carried on business in a somewhat retiring spirit, as did the International Filaments, Ltd. (formed to exploit the



Section of Blow Department.

process for export), the large facilities of the factory at Horsell Road, Highbury, were soon severely taxed. The Syndicate set out to trade on two lines: to supply "Metalite" filaments to electric lamp manufacturers, and to produce complete lamps themselves. In both directions they met with success. The high character of this success is seen when we consider the unimpeachable tests carried out by the National Physical Laboratory at Bushey Park. In a series of tests under the supervision of Mr. C. C. Paterson, two "Metalite" lamps, marked A and B, were pitted against half a dozen metal filament lamps of reputed brands, each bought as 25 c.p. lamps. Current was used at 110 volts. The results were as follows:—A, mean horizontal c.p. 26·8, watts per mean horizontal c.p. 1·14, amperes 0·278: B, m.h.c.p. 27·2, watts per m.h.c.p. 1·11, amperes 0·273. The best of the competing lamps gave:—Mean horizontal c.p. 25·3, watts per m.h.c.p. 1·45, amperes 0·333. The others ranged from 24·5 to 17·6 c.p. This was certainly something of a triumph for British skill and

Part of Control Department.

enterprise. This success was admitted both at home and abroad. Dr. C. Heinrich Webber, of Charlottenberg, one of the best-known experts on the subject, declares that out of the great quantities of metallic filaments he had tested chemically he had found the carbon percentage ranging from ·05 upwards, whilst in the British "Metalite" it was not more than ·008. No doubt this accounts for the pure whiteness of the light given off, the steadiness of the light, and the long useful life of the filament. Moreover, the low percentage of carbon makes it more flexible, consequently less brittle and liable to damage from vibration or sudden changes of temperature.

Another Corner of Laboratory.

The central station engineer may, in moments of unguarded pessimism, regard the British "Metalite" lamp somewhat askance, for it is a very powerful current economiser. On the other hand, the inventor's process is such that these lamp filaments are produced at a moderate price, and of a quality to last long, so they may more justly be looked upon as excellent popularisers of the use of electric current.

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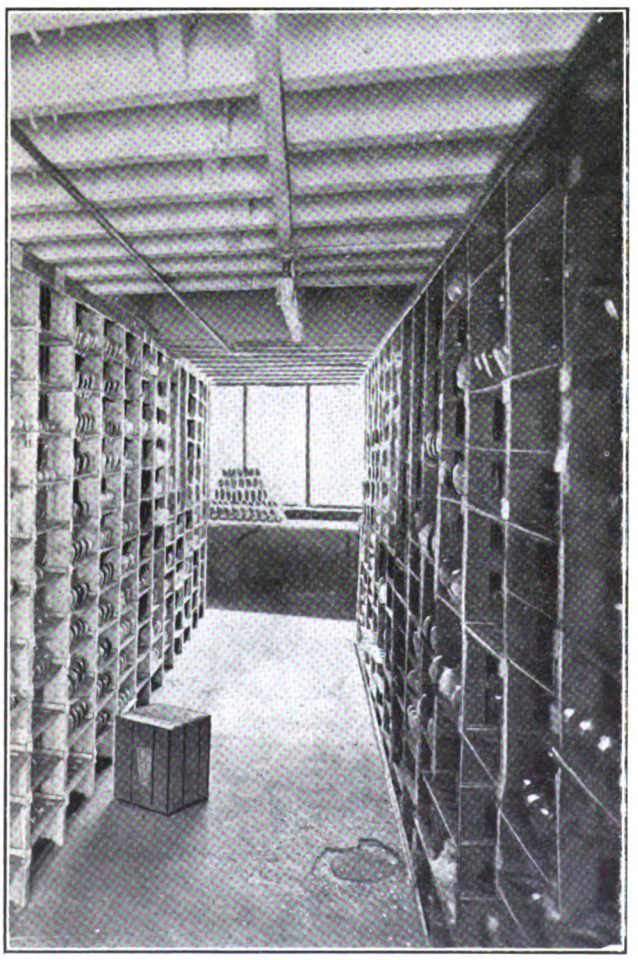
It may be fairly claimed that the "Metalite" filament is playing a conspicuous part in the revolution now taking place both in public and private lighting. As proof of this we may point out that the Bryant Syndicate have almost more work than they can cope with in supplying

ANOTHER SECTION OF CONTROL DEPARTMENT.

the wholesale trade and over fifty corporations, while the International Filaments, Ltd., have orders on hand for America alone exceeding fifteen million filaments. All things considered, therefore, it is not to be wondered at that it has been decided to extend the factories, and to this end a new company is about to be formed, which will take over the two existing concerns, and, with the increased capital, start on a fresh series of conquests. It may be said that the company, whose prospectus is now ready for issue, will have a very powerful board, while Mr. E. Harrison, A.M.I.E.E., will remain as engineer.

Our illustrations will give a good idea of the present extent of the business. Shortly we shall be in a position to give details as to future developments.



A SECTION OF STOCK DEPARTMENT.

LEGAL.

Marine Electric Propulsion.

At the Patent Office, on the 7th, the Comptroller had before him the case of Mr. W. Durtnall and the Hon. C. A. Parsons. The question in dispute is whether the specification of an invention by the latter concerning the use of electric apparatus in the propulsion of ocean-going vessels does or does not infringe a patent of Mr. Durtnall's, embodying his inventions of 1905. The final decision in the matter is one that affects the rights to an invention which may exercise a great influence on the future of marine propulsion generally. The Durtnall patent, it is claimed, is a method of so combining a high-speed engine, an electric installation of dynamo and motor and a propeller that the engine, or prime mover, can be run at its most economical speed, while driving the propeller much slower, and so raising the efficiency of the latter in relation to the power used, and the speed of the vessel, without any undue loss of power in transmission. This combination involves the use of what is known as a polyphase-motor, and in the Parsons specification of 1909, embodying an arrangement with a similar object, a polyphase-motor is also included. The contention of Mr. Durtnall was that his invention was the first attempt to utilise the polyphase principle in this specific manner. The arguments pro and con involved a great mass of technical details, but ultimately Mr. Durtnall agreed that he would be quite satisfied if the specification of the Parsons patent included a reference to his own so far as the polyphase principle was concerned. The Comptroller said that he would give the matter consideration and announce his decision in due course.

PERSONAL.

Mr. A. D. Hill, for many years in charge of the Rhyl district electricity and telegraph departments of the London and North-Western Railway Company, has been promoted to be assistant to the general superintendent at Euston.

Mr. H. J. Hawkins, for three years deputy borough electrical engineer, has been promoted to borough electrical engineer at Salford, at a salary of £500, rising by £50 annually to £700.

The London Board of the Bombay and Baroda and Central India Railway Company have obtained on loan for a period of two years the services of Mr. A. E. McCloskey from the General Post Office Engineering Department, England, and have sent him out to India for employment as assistant electrical engineer for the company's telegraph branch.

The members of the South-Eastern District of the Institution of Municipal Engineers have elected Mr. Henry C. Adams, consulting municipal engineer, of 60, Queen Victoria-street, London, E.C., as their chairman for the second year in succession.

Mr. J. W. Saaler, of Bruce Peebles & Company, Ltd., was married on the 12th inst., at St. Margaret's Church, Westminster, to Miss Frances R. Knott, of Southsea, a reception being afterwards held at the Westminster Palace Hotel. Mr. and Mrs. Saaler sail on Saturday by the R.M.S. "Saxon" for South Africa, where Mr. Saaler is taking up an important position for his firm in Johannesburg, and we are sure he has the good wishes of his many friends on the occasion of this double event. Mr. Saaler has been in charge of Messrs. Bruce Peebles' Manchester Office for some time past, and the vacancy caused by his leaving is now filled by Mr. H. B. Tilley, who has been with the company for a number of years.

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COMMERCIAL PROGRESS OF ELECTRICITY UNDERTAKINGS.*

By H. Collings Bishop, Chief Electrical Engineer, Newport, Mon.

The past three or four years have seen the development of the commercial side of electrical undertakings to a far greater extent than at any previous time. Engineers have recognised the fact that they must pay as much attention to that side of the business as they have in the past done to the engineering side, so that at the present moment electrical engineers have practically double duties to perform. It is to be hoped that these notes will serve the purpose of obtaining from the various engineers information as to the progress made in their own particular districts.

In the undertaking managed by the author the progress made in the past three years is in his opinion satisfactory, but still open to many improvements, chief amongst which may be mentioned the question of show rooms. Like so many other towns, Newport has suffered from the difficulty of obtaining a proper site for a show room and is therefore still content with a back room as the only means of displaying electrical apparatus.

At the present time no town need suffer from the want of advertising matter, as plenty can be obtained free from the various manufacturers if one is prepared to push their goods, and there is more than one company in existence which is prepared to supply any amount of literature in return for the coin of the realm. As to whether advertising matter so obtained is suitable must depend to a great extent on local conditions. Personally the author does not consider it altogether advisable to depend on matter made up in London as a suitable means of advertising, say the Newport undertaking, a hundred and fifty miles away. What will suit one town will not necessarily suit another, and it is wise to carefully suit one's language to the particular type of individual to be addressed. The author is of opinion that the correct way to deal with the problem is to make up your own advertising matter to suit your special requirements even though the standard of literary art may not be up to that of the expert.

The author has spent a good many years in America, but has not returned with the American idea of advertising, which necessitates dumping a postcard or letter on your breakfast plate every day until, from sheer exhaustion, you succumb and give an order. This sort of thing can be overdone. In Newport the sending of numerous letters, postcards, etc., was tried for some time but the results were not nearly so good as dealing individually with prospective consumers, and using your judgment when to give them a rest. Circularising specialities is another matter and can very well be done in the first instance by circular, to be followed by a call showing the article you want to introduce. When that article is likely to be suitable, such, for instance, as an iron, it should be left for a week's free trial. Nine times out of ten this will result in a sale. It is no good writing to a man worth £2,000 a year suggesting say the purchase of electric radiators at 5s. a quarter, or to ask an artisan to buy cooking apparatus costing £30 or £40. The essence of successful advertising is good judgment.

Canvassing is the most important of all the departments connected with the commercial development of electrical undertakings, and those undertakings able to support a canvasser and illuminating engineer are indeed in a fortunate position and, given a good man, the committee will never regret the appointment. Payment by commission should not, in the author's opinion, be indulged in. It leads to the temptation to get work whether the prospective consumer is financially sound or not, and in the end the undertaking suffers. On the other hand, if a man is paid a salary he will be more inclined to be careful whom he obtains as consumers and he will also be more inclined to spend time in going into details.

Two or three years ago the Newport Corporation appointed a combined canvasser and illuminating engineer, and the appointment has been an unqualified success, not only in the way of obtaining new consumers but in satisfying those who grumble. He has also been able to cover practically the whole of his salary by the casual sale, during his rounds, of lamps, irons, radiators, etc. The appointment has undoubtedly resulted in more contented consumers, less grumbling, and increased business and the author would strongly advise those undertakings which have not launched out in this department to do so at once. The mode of procedure in Newport has been as follows: The canvasser works directly with the consumer or prospective consumer and reports daily to the chief the result of the previous day's work, and generally discusses the work in hand. By this means there is a minimum of delay in giving the prospective customer a definite reply, the canvasser becomes daily more acquainted with the policy of his chief, and is gradually able to deal more quickly with customers, and when the necessity arises of taking the responsibility of giving a decision on a matter at the moment, he is able to settle without feeling that he has taken any risk of disapproval. There is no doubt that a customer likes the man who has called upon him to be able to give a decisive reply without having to wait whilst the matter is referred to the office, and the close co-operation between the chief and the canvasser enables this to be done.

Another important point when dealing with prospective consumers is to gauge the correct time for the manager to step in and see the new consumer. Cases are not infrequent where the canvasser has a certain difficulty in persuading a man to decide the matter in hand, and in such cases good is often done if the manager takes the trouble to see the individual himself. This refers rather to the smaller jobs, the experience of the author being that in the larger jobs he has to do a great deal of the negotiating himself.

Installation Work.—This question is a very debatable one at the present time. There is no doubt that, were the field free, the electrical undertakings are in an excellent position for dealing with all the necessary installation work for their own consumers, and a good percentage of electricity users prefer that all repair and installation work should be carried out by the undertaking. Newport, which possesses full powers for dealing with all work connected with the undertaking, has so far rested content with carrying out such work as has been directly thrust in its way and in carrying out work under the hire or hire purchase systems. The general run of work has been left to the contractor. The number of consumers who now send direct to the electricity department is, however, growing rapidly, showing that they really prefer the work being carried out by the supply authority.

One is often asked, What is to become of the contractor? The author's reply would be that the properly trained and conscientious contractor has little to fear, but the man who becomes an expert in a night, must in the interest of the whole industry, go. A great deal of harm is being done by these men, and also by some of the large plumbers and ironmongers, who often put on an inexperienced man as electrical foreman and leave the whole department to him. The amount of work done is often large, owing probably to the reputation of the firm in their legitimate line, and the public naturally think that they are getting a first-class job done. In many cases they are disappointed.

To give one example of the kind of work done by some of the so-called electrical engineers who invade so many of the towns to the detriment of the qualified firms: A small job of arc-light wiring was sublet to a local firm. The total run consisted of about 80 yards of cable. Some time afterwards it was found necessary to remove the cables and it was then discovered that there were 21 joints (there were no branches), not a single one of which was either cleaned or soldered, and no attempt had been made to properly insulate the copper, save by a small quantity of sticky tape, bought for about 9d. per lb. Unfortunately, the consequences of the sins of the incompetent wireman very seldom fall on the individual concerned, but rather on the industry as a whole. Happy the undertaking that has the necessary installing powers. The ground is smoothed of many troubles and the difficulty in persuading many people to become consumers is lessened.

Motive Power.—In the author's case he has yet to find the consumer who discards electric power once he has started, except due to failure in business or other like cause. The ease of starting, and the knowledge that the power is always available for use are strong arguments in deciding people to change over from older methods of motive power

* Paper read at the Municipal Electrical Engineers Association, Glasgow.

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to the more modern one. It is, however, necessary to run the hire department upon business lines. Ten per cent. to cover interest and all other charges, based upon the cost price, is bound to end in a loss to the department. Neither does the author consider it at all necessary to make the hire rate very low in order to obtain consumers. In Newport there has been no difficulty in obtaining 20% return on the cost price.

It may be of interest to know the rates obtained in Newport for the hire of various sizes of motors. The figures given include a starter, switch and fuses, and wiring up to a run of 50 ft.

	£	s.	d.
1 h.p.	2	17	6
2 h.p.	3	10	0
10 h.p.	7	5	0
25 h.p.	13	0	0
50 h.p.	23	0	0

Arc Lamp Hire.—This is a department that has not been started by a great number of undertakings, nevertheless it is one that has many points worthy of consideration. There are two chief reasons that deter consumers from installing arc lamps, viz., first cost and the bother of trimming and cleaning. The author has found it most successful to undertake both duties, and in Newport there are at the present time 283 arc lamps on hire from the Corporation. The whole of these lamps are maintained by the Corporation for an inclusive fee per hour (in use) for current and carbons. In addition to these there are 55 lamps owned by consumers, but maintained by the Corporation at a given sum per annum, such sum depending upon the size of lamp and hours of use. There is no doubt that lamps so maintained give better results than when trimmed by the consumer.

The rates charged in Newport are as follows :—

One 360-watt alternating lamp, 2d. per hour.
One 400-watt alternating lamp with metal core carbons, 2½d. per hour.
Two 400-watt alternating lamps with metal core carbons, 5d. per hour.
Four direct-current metal core carbon 400-watt lamps, 10d. per hour.

The above rates are for yellow carbons.

The rates charged for the hire of the lamps are as follows :—

One alternating lamp and transformer, £2 8s. per annum.
Two alternating current lamps, £4 3s. per annum.
Four direct current lamps, £6 18s. per annum.

Hire Purchase.—In this department we deal with almost any kind of apparatus that a consumer may require, both for lighting, heating, and power, and we vary the payments from one year to five years as may be required. The business done has been fairly good, without unduly pushing it; that is to say, if we think a consumer is prepared to buy outright we leave him to the contractor, but when we know it means deferred payments then we push the scheme for all it is worth.

The author has found this scheme popular, even amongst those who are able to pay outright, for the reason that they like to have the maintenance in the hands of the Corporation. The basis of charge varies slightly according to the class of apparatus purchased, but the general run is as follows, say for a five years' agreement.

Payments per Quarter :—

One-twentieth part of the capital.
Five per cent. interest on capital not repaid.
Five or ten per cent. on total capital for maintenance.

Inspection.—In 1906 the author mentioned the question of inspection, and was criticised by one member as advocating red tape. The author abominates red tape of any sort and keeps all agreements, applications, etc., down to the smallest point, and for the same reason the published regulations are as short as possible. But he is still of opinion that some form of inspection is required and the chief point to consider is, who is the right authority to undertake it? It used to be said that this should be done by the municipal authority, but now that so many Corporations undertake installation work themselves it is questionable if they are the right ones to do inspection of work that may be done by a competitor.

Charges for Energy.—Strictly speaking, this is a fitting subject for a separate paper, but at the same time it is an important factor in the progress of an undertaking, not so much from the point of view of the amount to be charged, that must be governed by local conditions, but the system by which those charges are made. It will be agreed to, by some at least, that a general flat rate, although simple, is not satisfactory because it does not afford that flexibility that is necessary.

The maximum demand system has been found wanting by many, and the town that has four pages of varying charges is laughed at by many engineers and grumbled at by the poor consumer, who does not know which to adopt. At the same time the author ventures to say that there must be a reasonable number of varying charges to permit him to satisfy the most difficult of prospective consumers that it will pay him to adopt electricity.

Below are given the rates in force in Newport, and even if it is considered that there are too many alternatives, at least it will be admitted that they are flexible enough to deal with most of the cases that may arise.

Ordinary Lighting :—

First 1,500 units per quarter, 4½d. per unit.
All used above 1,500 units per quarter, 3½d. per unit.

A guarantee of 10,000 units per annum permits a nett charge of 3½d. per unit being made for the whole quantity. Power users have special lighting rates that vary from the maximum down to a nett charge of 1d. per unit if sufficient power units are used.

Power Rates :—

General scale, 2d. per unit, falling as low as 1d. according to quantity.
Guaranteed 20% load factor, 1d. per unit nett.
Below 20%, but with a guranteed use of 100,000 units per annum, 1d. per unit.
By two-rate meter, 3d. per unit during the restricted hours and 1d. per unit during other hours.
Heating—1¼d. per unit nett.

Accounts not nett are allowed 5% discount if paid within one month.

Gas Competition.—Does gas competition really exist at the present time? This is a question that is bound to be answered in a great many different ways. The author ventures to say that it does not exist to nearly the same extent that it did a few years ago. There is no doubt that the advent of the flame arc and the metallic filament lamp has put quite a different complexion on matters. Where the competition really does exist is with the small consumer, who, at the present time, uses gas, oil or candles. Here there is a great field for activity. One is able now to successfully attack that stronghold of the gas company—heating, and the gradual increased consumption in heating units that is being made each year is bound to tell in time.

Free or Assisted Wiring.—Many schemes have been tried for inducing the smaller consumer to take electric light by offering to wire premises free or for a small rental, but there are not many cases where it has been a success. A better plan, in the opinion of the author, is to put forward the prepayment meter, and in Newport considerable success has been obtained in this line, some 50 to 60 meters having been put out during the past seven or eight months. This, however, does not overcome the difficulty of obtaining the very small consumer whose demand does not exceed two or three lights. Prepayment meters in these cases are no good, because the revenue allowed in the charge made is not sufficient to make a sufficient return on the cost of the meter, and the author now puts forward for consideration a scheme for the inclusive rental of wiring and energy. Whilst the plan proposed is going back to the system in vogue many years ago, still there is no reason that it should be a bad idea simply because it is old. Probably the greatest objectors will be the meter manufacturer.

Briefly the scheme is as follows :—

To charge a weekly rental for current and hire of fittings.
To use a cheap form of surface wiring.
A variable weekly rental according to the time of the year.
An arrangement by which all rooms can be wired and a varying rate charged according to the number of lamps it is desired to have power to light up at the same time.
A locking holder to minimise the theft of lamps.

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A scale of weekly rents is given for the varying conditions that may arise.

The charges shown on the scale are based upon the following rates :—

Charge for energy, 4½d. per unit.
Capital cost for wiring (without lamps), 10s. per point.
Capital cost for each service, £0s. (The author may have an opportunity of showing how he proposes doing this at the price, in the discussion that will probably take place on another paper.)
Capital cost of the instrument to prevent the use of more lights at a time than are paid for—15s.
Collection charges—1d. per house per week.
Annual allowance per lamp for renewals—2s.

The average number of burning hours per annum has been based on the following :—

One point installed—1,000 hours per annum.
Two points installed and two lights permitted at a time—1,300 hours per annum.
Three points installed and two lights permitted—1,300 hours per annum.
Three lights installed and three lights permitted—1,500 hours per annum.
Four lights installed and two lights permitted—1,300 pours her annum.
Four lights installed and four lights permitted—1,700 hours per annum.
Five lights installed and three lights permitted—1,500 hours per annum.
Five lights installed and five lights permitted—1,900 hours per annum.
Six lights installed and two permitted—1,300 hours per annum.
Six lights installed and six permitted—2,000 hours per annum.

Following is a list showing how the annual costs and profits should work out per hundred consumers, taking various classes so as to get a fair average :—

	£	s.	d.
10 one light permitted and one point wired consumers—annual revenue	11	16	8
10 two lights permitted and two points wired consumers—annual revenue	15	4	2
10 two lights permitted and three points wired consumers—annual revenue	16	5	0
10 three lights permitted and three points wired consumers—annual revenue	17	9	2
10 four lights permitted and four points wired consumers—annual revenue	19	10	10
10 two lights permitted and four points wired consumers—annual revenue	17	6	8
10 five lights permitted and five points wired consumers—annual revenue	21	16	8
10 three lights permitted and five points wired consumers—annual revenue	19	10	0
10 six lights permitted and six points wired consumers—annual revenue	23	8	4
10 four lights permitted and six points wired consumers—annual revenue	21	13	4
100 consumers	£184	0	10

The cost per annum of running these hundred consumers would work out as follows :—

	£	s.	d.
5,330 units at ·75d.	16	13	1
Interest and repayment on installation costs..	6	5	0
Interest and repayments on services	7	10	0
Interest and repayments on the proportion of plant and mains required (basis maximum demand 5·6 kw.)	21	0	0
Collection expenses	21	13	4
Lamps	16	0	0
Limiting apparatus and terminal costs.. ..	15	0	0
Total	£124	1	5
Nett profit	£59	19	5

Allowing 20% in extra units for waste, the nett profit is reduced to £56.

Since writing the above scheme the author has come across an article on the proposals of the Fixed Price Lamp Co., and, curiously enough, it appears that he has hit upon a very similar scheme that it is the intention of that company to carry out, with the following differences. The author's scheme provides for the collection of accounts, the supply of lamp renewals, a limiting device, etc., and the company do not collect accounts, supply lamps, or apparently use a limiting device. The price proposed by the company, viz., 2½d. in the summer and 3½d. in the winter, appears to the author to be too low when dealing with lamps up to say two in number. When that number is exceeded the two schemes appear to agree fairly well in price.

DEVELOPMENTS IN TELEGRAPHY AND TELEPHONY.

By Sir John Gavey, C.B., M.Inst.C.E.

(*Continued from page 34*).

Again, the close of the conversation had to be indicated by the subscribers ringing off by means of their calling apparatus, an operation often forgotten by a busy, careless or uninstructed user. If, therefore, the connection between the subscribers remained for an unreasonable time, or if another subscriber desired to speak to one of those supposed to be engaged, the operator had to come into circuit, listen for a moment, then, hearing nothing, ask "Have you finished?" before severing the connection. To obviate all these sources of delay the "common battery system" was designed. In this the form of manual exchange equipment now considered the most satisfactory, the shutter indicators are replaced by glow-lamps which, being very small and occupying no more space than the jacks themselves, are placed immediately over the latter. When a lamp lights it indicates a call and the operator, without doubt, hesitation or delay, forthwith inserts the answering plug into the jack. At the subscriber's office no special calling apparatus is needed. The lifting of the telephone from the hook automatically lights the lamp. When the operator has ascertained, by touching the metallic rim outside the subscriber's jack with her connecting plug, that the subscriber who is wanted is free this plug is inserted, and its insertion is followed by the glowing of a supervisory lamp near the plug seat, there being two of these to each set of cords and plugs. The operator then gives a brief ring and when the called subscriber takes the telephone off the hook to answer this is evidenced by the supervisory lamp being extinguished. The operator has no further concern with the connected lines until both subscribers restore their telephones, when both the supervisory lamps glow, the connection is severed. the lamps darken and the normal condition is restored, The work of the operator is conducted with absolute certainty, no breaking in to ask questions is necessary, she knows by the glowing or extinguishing of the supervisory lamps whether the subscribers are talking or have finished, and all her speech on the line can be reduced to "Number, please," and perhaps "Subscriber engaged" or "Subscriber don't answer."

This simplicity in manipulation is, however, as might be assumed, arrived at by considerable complication of apparatus which if dealt with in detail would take up a whole evening.

The electrical energy in common battery systems is, as may be inferred from the name, provided by accumulators at the exchange instead of by primary batteries at each subscriber's office, and not only is the cost of the exchange infinitely small as compared with the old system of providing separate batteries for each subscriber, but the further advantage follows that the full energy is always maintained and available on every circuit, a condition almost impossible to fulfil even under the best organisation when thousands of primary cells scattered over a great city have to be looked after by linemen, some of whom may do their duty less conscientiously than others, whilst some subscribers may exhaust their batteries by careless user quicker than should be the case.

Similar automatic arrangements are in use on the junction lines connecting the various exchanges necessary for the effective service of large cities.

In the period during which the ordinary telpehone equipment has undergone the modifications just described, inventors have turned their attention to the design and

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perfection of an automatic telephone in which each subscriber, by a simple method of manipulation, may without the intervention of an operator at the exchange obtain direct access to any other subscriber connected with the service. One of the earliest systems of this type was known as the Strowger, owned by the Automatic Electric Co. of Chicago, and represented here by the British Insulator & Helsby Co. Each subscriber's line terminates on a line switch which forms part of a group of 100 switches. This switch is connected by 10 circuits, the equivalent of the plugs and cords in a manual board, with a series of selectors each accommodating 100 junction lines. According to the size of the exchange there may be two or three sets of selectors connected similarly by means of junction circuits, and finally, there is a connector, a somewhat similar instrument, which makes the connection between the two subscribers. Each telephone has a dial with finger holes and numbers. On removing the telephone from the hook the procedure is as follows: If, say, No. 4852 is wanted the caller inserts his finger in hole 4 and revolves the dial up to the limiting stop. This actuates the line switch which causes a connecting plug to enter the springs of the first disengaged junction leading to the selector group of 4,000. The same action follows in sequence with 8, 5 and 2, the final movement of the connector making the connection if the required subscriber is disengaged. If he be through to another a busy back singal (a vibratory current) is given. When the connection is made and the conversation is complete the hanging up of the telephones restores the connections to the normal.

This method has had considerable development amongst the independent telephone companies in America.

On the subject of the future development of telegraphs and telephones, few of those acquainted with the subject would venture to dogmatise, but certain statistics I have prepared will convey to you possibilities far more pregnant than any amount of speculation. The following figures, for the years 1902 and 1907 respectively, have been gathered from authentic returns, and they embrace information from every country of importance throughout the world.

TELEGRAPH AND TELEPHONE STATISTICS—WIRE MILEAGE.

	1902.	1907.	Increase.
TELEGRAPHS.			
Land wires	3,659,659	5,038,981	1,379,322
Submarine cables ..	212,894	259,000	46,106 = 21.6%
TELEPHONES.			
Wire	7,467,417	19,839,537	12,372,120
Subscribers' stations	3,534,036	8,406,336	4,873,330

Large figures frequently fail to impress the mind, but when it is stated that this mileage of wire will soon, if it has not by this time, equalled one third the distance from the earth to the sun, the remarkable activity of the modern telegraph and telephone service will perhaps be more forcibly realised.

It will be observed that although the development of the telephone service is taking place with giant strides, telegraphs, both land and submarine, have shown remarkable growth in the intervening period of five years, notwithstanding the keen competition of the telephone. The great increase in the latter service, however, has taken place within a relatively limited period of time. In 1896 when the associated companies using the American Bell systems only possessed 300,000 telephones. In 1905 this number had risen to 2,000,000, and in 1907 to 3,000,000, whilst at the beginning of the present year the corresponding figures are 5,100,000.

My somewhat brief and hasty generalisation of the subject has not admitted even of reference to many subjects of interest such as combined telegraph and telephone working on the same wires, the use of repeaters to increase the speed of working on long lines: nor have I been able to refer to other aspects of telegraphy such as modern fire-alarm systems, railway signalling, etc., to which the public owe much in shape of immunity from danger and accidents; but I trust that what I have said will show that this, one of the earliest branches of electrical engineering, is not stagnant, but, on the other hand, it is very much alive; it is served by some of the keenest and most advanced of electricians, and it is absorbing annually a large amount of capital which it is turning to good and profitable use.

The time that has necessarily been taken up in dealing, even in a somewhat sketchy way, with the preceding subjects has left little space for wireless telegraphy, but I am told that under no circumstances must I pass it by without mention.

The idea of telegraphing without wires goes back to the early days of telegraph working, and methods were designed, partly based on earth-induction and partly on electro-magnetic induction, which admitted of communication over limited distances. Even at the present date there are two existing examples of this method in the United Kingdom, one a wireless telegraph service between Rathlin Island and the north of Ireland, a distance of 8 miles, and the second, a wireless telephone between the Skerries Island and the Holyhead, a distance of 3 miles. The range, however, attainable, was so small that, when Marconi introduced a system based on the work of Hertz and other notable investigators, further attempts to improve the older method ceased.

It was known by Henry, after whom the unit of self-induction has been named, that the discharge of a Leyden jar, which to the eye appeared as a single spark, was really of an oscillatory character, and Hertz proved that when a powerful induction-coil was connected to two conductors separated by a spark-gap, each time a spark occurred the oscillations that were set up in the conductors cause electric waves to traverse the ether. He analysed these waves by interposing a metallic ring, provided with a microscopic spark-gap in their path, the passage of the waves being evidenced by a spark at the gap. This detector was not fitted for telegraphic use, but the subsequent invention by Branly of a more effective detector, the coherer, paved the way for Marconi's work.

Marconi in the first instance connected one terminal of an induction coil to a lofty vertical conductor and the other terminal to earth. Each discharge across the gap resulted in electrical oscillations in the vertical conductor, and these oscillations caused electrical waves to radiate through space. As these waves cut across other vertical conductors electrical currents were generated which acted on the coherers, and signals were recorded. These waves were, however, highly damped, and practically only the first rapid rise had any material effect on the receiving apparatus, so that under these conditions all stations within range were affected by the signals. Further, as these oscillations had a frequency of the order of a million per second and the impulses from the induction coil were of the order of 10 per second, there were relatively very long intervals between each successive wave emission. The attention of all those interested was, therefore, directed towards the discovery of selective apparatus by tuning, and to effect this object endeavours were made to replace the highly damped by as near an approach to undamped waves as possible. This was partially effected by establishing an oscillating circuit consisting of a capacity and an inductance around the spark gap of the induction coil, so that the oscillations would be more continuous than in the first case, the vertical conductor being connected either directly or inductively with the oscillating circuit, and thus the first measure of success by selective tuned circuits was achieved. So long, however, as ordinary induction coils with their slow make and break arrangements were in use, the relatively long idle period between successive oscillations still existed, and the ideal system of absolutely undamped waves remained unattained.

A further stop in advance was achieved by Poulsen, who replaced the spark-gap by an arc, and thus obtained an enormously increased number of primary impulses, so that the emitted waves were more and more continuous, and this method has been followed by that designed by Lepel in which the arc is replaced by two or more metal discs separated by a minute space.

By substituting a telephone transmitter for the ordinary telegraphic key, it has been found possible to transmit actual speech a distance of 30 or 40 miles, whilst the limit of telegraphy may now be placed at perhaps 5,000 miles.

Each system fills at present a definite sphere, and we have by no means arrived at finality in this interesting branch of the earliest type of electrical engineering.

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GALVANOMETER FOR A.C. CIRCUITS.*

By Dr. W. E. Sumpner and W. C. S. Phillips.

Tests of effects due to change of current, such as induction phenomena, are often hard to carry out because the ballistic galvanometer available is not sensitive enough. Alternate current tests are still less satisfactory owing to special difficulties. The vibration galvanometer overcomes only a few of these difficulties. It must be adjusted to resonance for the best effects, and its indications vary with current frequency. The sensitiveness of ballistic galvanometer tests can be greatly increased by the use of some form of mechanical commutator by means of which a crude form of alternate current is produced. A better method would be to generate the current in the usual way if a suitable instrument existed. The galvanometer here described is the result of an attempt to construct a measuring instrument by means of which inductances and capacities can be compared by bridge methods as accurately as it is possible to compare resistances. The instrument is like a moving coil galvanometer in almost every respect, except that its field is due to a specially constructed electromagnet excited by an alternating voltage. This voltage V is applied to a winding of m turns of the electromagnet, and the core flux N is such that

$$V = rA + mN,$$

where r is the resistance of the winding and A the current traversing it. The coil and electromagnet are so designed that for currents of the frequencies used the value of rA is negligible in comparison with V. The rate of change of N will therefore be at each instant a measure of V, whatever the permeability or hysteresis of the core. The instrument has a laminated electromagnet formed of stampings of two kinds—a rectangular portion with two straight limbs forming the core of the electromagnet, and a specially shaped stamping between the poles. The moving coil of 50 turns swings in a narrow gap separating the stampings, in much the same way as in a permanent magnet instrument. On the limbs of the magnet are windings of 200, 2,000, and 4,000 turns. The iron will not be too strongly magnetised if the winding used contains 20 turns per volt on 50 ~ circuits, but the instrument is so sensitive that such excitation will only be needed for exceptional tests.

If a voltage V be applied to one of the field coils of m turns, and if the same, or another, field winding of n turns be joined up, through a condenser of K microfarads, to the moving coil, the torque acting on this moving coil will be a measure of

$$Kn\left(\frac{V}{m}\right)^2;$$

i.e., the deflexion is proportional to the square of the voltage. By suitably choosing K, m and n, the voltmeter may be used over a large number of ranges. Thus with the instrument shown a deflexion of 200 mm. on a scale at 1 metre distance, can be obtained either for 200 volts or for 20 millivolts. The deflexion is independent of frequency and wave-form if the field-winding to which the voltage is applied has a resistance negligible in comparison with its impedance. Thus with m = 4,000 and n = 200 it was found that the value of V^2 required to give a certain deflexion was independent of frequency between 50 ~ and 100 ~, but at 25 ~ it was 6½% less than at 50 ~. At any fixed frequency the deflexion will always measure KV^2. The instrument may be used with great advantage to compare inductances and capacities by the ordinary bridge methods, the working conditions being (i.) the alternating voltage V applied to the field coil of the instrument must also cause the current in the bridge conductors, (ii.) the alternate current in the bridge must be made in phase with the voltage V by the use of suitable non-inductive resistances, (iii.) the moving coil must be placed directly across the bridge.

The balance can be adjusted with ease to 1 part in 10,000 when the voltages set up on the coils or condensers are of the order of 1 volt. When a balance of great precision is needed, the minute electromotive force e induced in the moving coil by the alternating field of the magnet, tends to cause a small deflexion disturbing the balance. When the moving coil circuit is non-inductive, the current due to e will be in phase with e and in quadrature with the flux so that the corresponding deflexion will be negligible. But in all cases any effect due to e can be accurately eliminated by working to a false zero. As illustrations of the behaviour of the instrument, the results of tests are given on the measurement of the mutual induction of coils, the comparison of capacities, and the measurement of specific inductive capacity.

Discussion.

Mr. A. Campbell expressed his admiration of the galvanometer and in particular of the ingenious method of connecting it with a condenser when voltage is to be measured. He remarked that the instrument was very similar in construction and use to that used by earlier experimenters. Stroud and Oates (Phil. Mag. 1903) described such a galvanometer and showed how sensitive it was for testing condensers by Anderson's method and for other purposes; and Terry (Phys. Review, 1905), used a similar one for accurate comparisons of condensers. Abraham (*Comptes Rendus*, Apr. 1906) described another in which the false zero was got rid of by a compensating arrangement.

With regard to vibration galvanometers, there is no difficulty in keeping them in tune on any reasonably steady alternating circuit. In the bridge methods illustrated in the paper, a double adjustment is necessary when a vibration galvanometer is used, and in general an evaluation of effective resistance or leakage resistance can be made simultaneously with the measurement of inductance or capacity. He asked the authors if this double adjustment can be entirely dispensed with when the quadrature galvanometer is used. It would be interesting also to know how the instrument would work with non-sinusoidal wave-forms in a case where the balance depended on the frequency.

Mr. W. Duddell asked if the authors could supply more numerical data so that the instrument could be compared with other galvanometers of similar design. He pointed out that the tests were simplified owing to a double adjustment being unnecessary.

Mr. Irwin thought that with small modifications the instrument would be useful for tests other than those described in the paper. It might for example be used in determining the resistance of electrolytes. He pointed out that errors might arise due to a small amount of magnetic material in the moving coil.

Dr. Sumpner stated, in reply to Mr. Campbell and Mr. Duddell, that the object of the special shape of pole-piece was to increase the impedance of the exciting coil. Electromagnet galvanometers were not new, but the special mode of controlling the magnetic flux by the applied voltage was novel. The behaviour of the instrument was a direct consequence of this device. The vibration galvanometer responded to a voltage irrespective of its phase, and hence in some tests troublesome double adjustments were needed. This was not the case with the new instrument in regard to any of the tests described in the paper. The current taken by the instrument could easily be calculated from data given in the paper. In reply to Mr. Irwin, the author said that the small deflexion due to magnetic impurities in the moving coil could be eliminated in all balance tests by using a false zero method. In deflexional methods the effect could be rendered negligible by reducing the voltage exciting the field, and using a moving coil current of correspondingly increased strength.

Mr. Phillips stated that the present paper was preliminary to a more detailed account of the work which had been done with the instrument. In reply to Mr. Irwin, he stated that it was proposed to make use of the instrument to measure the specific inductive capacity of materials and the resistance of electrolytes.

* Abstract of paper read before the Physical Society of London.

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POSITIVE ELECTRIFICATION OF ALUMINIUM PHOSPHATE.*

By A. E. Garrett.

Mr. A. E. Garrett, in a paper entitled "Positive Electrification due to Heating Aluminium Phosphate," pointed out that in 1904 Dr. R. S. Willows and he had communicated to the Society the results of some experiments on the halogen compounds of zinc, in which it was shown that those compounds when heated ionized the air around so that both positively and negatively electrified bodies gradually lost their charge. Work in this direction was continued, and the results obtained showed that a large number of inorganic compounds possess properties of a like nature to the above. In 1907 Sir J. J. Thomson found that chlorides, phosphates, and nitrates give off an excess of positive ions when heated, and he incidentally discovered that aluminium phosphate was most active in this direction. As many of the substances previously examined are known to be unstable (and hence the ionization produced may be the result of chemical change), while aluminium phosphate on the other hand is a most stable substance, it was thought that an investigation of the ion producing properties of that compound would be of interest. The apparatus was arranged so that the salt could be heated to the desired temperature (900°–1,300° C.) on a strip of platinum foil. The pressure could be reduced as required. For most of the experiments a sensitive galvanometer was used as recording instrument. With the usual distance between the electrodes (0·5 cm.) it was found that a difference of potential of 60 volts was sufficient to obtain a saturation current with the positive ions. The way in which the current varied with the time when the saturation voltage was applied was first investigated. For the first half-hour the current was somewhat irregular. This was found to be due to the water present in the salt. The current for the first hour or two appears to be largely influenced by the surrounding gas. Neglecting the preliminary effects due to water, the decay of the current with the time can be represented by a curve having the general formula

$$A\,(e^{-\lambda^1 t} - e^{-\lambda^2 t}) + B\,(1 - e^{-\lambda^3 t}).$$

The current finally obtained depends almost entirely upon the salt itself. After 5 or 6 hours heating, no further change takes place in the current obtained under fixed conditions of temperature and pressure. A temporary increase, however, can be brought about by moistening the salt, and also by passing a discharge from an induction-coil through the tube for about ½ min. When the salt is insulated and heated for some time, an extraordinarily large current passes when the field is first put on. This effect increases with the time up to about 10 min., after which any longer insulation causes no increase of the initial current. With the salt in the final steady state the conditions were suitable for experiments on temperature and pressure effects. It was found that for every temperature tried there was a certain pressure at which the current obtained was a maximum, and the higher the temperature the lower was this pressure. The currents obtained with constant pressure and variable temperature indicate that the relationship between the rate of production of positive ions and the absolute temperature can be represented by the Richardson formula $ab\sqrt{\theta}\,e^{-\frac{Q}{2\theta}}$.

By using a quadrant electrometer in place of the galvanometer, it was found at pressures of 0·01 mm. that some positive ions are ejected with a velocity of the order 10^6 cm. per sec.; and other experiments showed that the ions at very low pressures and acted upon by small electrostatic fields moved with great velocity, so it was thought that this substance could be made use of as a means for rectifying alternate currents. It was found that it could be so used. The values of l/m obtained by Thomson's cycloid method indicate that the smallest of the positive ions present possess a mass comparable with that of the hydrogen atom. Many of the results obtained, in particular (*a*) those with varying pressures and constant temperatures, (*b*) those at atmospheric pressure in which after removal of all free ions by a field sufficient to produce a saturation current, a current of equal values for ions of both signs was found at an electrode placed behind that on which the saturation voltage acted, and (*c*) the loss of charge of a Faraday cylinder when screened from the action of free ions, indicate that one of the products due to heating aluminium phosphate is in the form of neutral pairs or doublets which afterwards split up into negative and positive ions.

* Abstract of paper read before the Physical Society of London.

ELECTRIC SMELTING IN SCANDINAVIA.

As regards the electrical smelting of low grade iron ores into pig iron at Tinnfos, near Skien, Christiania Fjord, H.M. Legation at Christiania report that the iron produced at the experimental furnace erected at that place, which can be manufactured at about £3 per ton, is capable of competing with the best Swedish "charcoal iron," costing from £5 to £5 10s. per ton. The production at Tinnfos is at present three tons a day; when the power at the works has been increased to 1,000 h.p., 25 tons a day will be turned out. The ore, which is smelted directly in the furnace, is said to contain 45 per cent. of iron. It is proposed to develop the works for the manufacture of steel, which it is said can be produced at from £4 to £4 10s. per ton, whereas Swedish "charcoal steel" of similar quality costs nearly £10 per ton. H.M. Legation are informed that there is a Swedish patented invention for the same purpose, which is said to give excellent results and to be more reliable, and that some furnaces are shortly to be erected near Christiansand.

Another patent is for the extraction of ochre by electricity from iron ore containing titanic acid. The ochre obtained is said to be five times as effective as ordinary ochre. My. Eyde, of the Notodden Nitrate Works, is interested in this scheme, and works are to be erected near Arndal.

From Sweden H.M. Consul at Stockholm reports that the Swedish installation financed by the Association of Iron Workers is, it is stated, being proceeded with satisfactorily at Trollhättan. At the same time experiments have been resumed with the original electrical furnace at Domnarfvet, and the superintendent has officially announced that the results are even more satisfactory than those hitherto obtained, and that he considers the economic problem of dealing with ore by electricity so that this method may supersede that of the blast furnace to be definitely solved.

A BRILLIANT IDEA.

A good idea occurred to a young man participating in a fancy dress roller skating tournament. Realising that a light touch is desirable in dancing and lightning speed in

skating, he thought he could not do better than turn himself into an Osram lamp, with the result shown in our illustrations, and, let us add, he carried off the prize.

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Situations Vacant, 24 words 1s., three insertions 2s. 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

TO SUBSCRIBERS.

THE ELECTRICAL ENGINEER *can be had by order from any Newsagent in Town or Country, and at the various Railway Stations; or it can, if preferred, be supplied direct from the Office on the following terms:*

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United Kingdom ..	3s. 3d. ..	6s. 6d. ..	13s. 0d.
Other Places	5s. 6d. ..	10s. 6d. ..	21s. 0d.

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Cheques, Post Office and Postal Orders for Subscription and Advertisements should be made payable to "THE ELECTRICAL ENGINEER," LIMITED, 149, *Fleet Street, London, and be crossed.*

Bound volumes of* THE ELECTRICAL ENGINEER, *containing half year's copies, bound in Dark-Blue Cloth, Gold Lettered, price 8s. 6d.

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TESTING WATER ELECTRICALLY.

Recently (Page 768, Vol. XIV.) we gave brief notes on an apparatus invented by Mr. C. V. Biggs and Mr. W. Pollard Digby for the determination of the specific resistance of liquids. The information given by Mr. Biggs has been amplified by a most interesting contribution, containing details of numerous experiments with curves, which will duly appear in the proceedings of the Institution. It is clear that these gentlemen have placed in the hands of central station engineers and others a most useful means for checking the purity of water. Hitherto, the methods of detecting the presence of small traces of impurities in distilled water by estimating specific resistance have required skilled operations and the "cloistered" quiet of a physical laboratory. Kohbrausch, with his alternating current, Wheatstone bridge and telephone receiver, depends upon that very fallible detecter, the human ear. The more accurate method of passing the liquid through a measured glass tube forming a secondary short-circuited coil of a static transformer, requires delicate handling and careful calculations. Something more simple and ready than these was needed for ordinary routine work, and wherein both A.C. and D.C. could be utilised. And such a piece of apparatus the authors have devised. Mr. Digby describes the instrument as consisting "of a glass U tube, and to this a tap is joined to the inlet at its lowest point. Near the extremities of the limbs of the main tube overflow ways are sealed on, and terminate in indiarubber tubes grouped with the lower outlet. The form and arrangement of the electrodes are especially designed to minimise the disturbing effects of polarisation and other difficulties inseparable from the original type of tube. The electrodes are open cylinders of platinum, about 9 mm. in diameter and 3 mm. in height, connected by three equidistant platinum wires to stout brass glass-covered rods passing

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through the brass covers which are connected to the terminals. The dimensions of tube and electrodes are such that the equivalent of a body of liquid having a length of 10 cm. and a sectional area of 1 sq. cm. is obtained. The apparatus is mounted on a strong wooden support carrying a thermometer, and the whole is contained in a lock-up portable case." For measuring purposes a specially constructed "conductance meter," somewhat in the form of a "megger," is used. It is marked with a scale graduated in reciprocal megohms and ohms, and has a tube of sectional area one-tenth the length. It gives readings of one-tenth of the specific conductivity—equivalent to the reciprocal of ten times the specific resistance. "Correction for variations of temperature for water containing less than 1% of dissolved salts," adds Mr. Digby, "may be made with sufficient accuracy by taking the coefficient as 2·19% per 1° C., as referred to 20° C., but above 38° C.; such correction is not reliable," mainly owing to the disengagement of minute gas bubbles. After considerable experimentation the standard for comparison was fixed at 3·3 reciprocal megohms, or a specific resistance of 300,000 ohms at about 20° C. for distilled water from surface condensers. It is outside of the scope of our present article to follow Mr. Digby through his extremely interesting records of experiments in the investigations of feed water, and the phenomena of condenser tightness and priming. He gives many instructive curves obtained by examinations at various central stations in different parts of the country. All these abundantly bear out the contention that now the examination of water by electrical methods is within the reach of every practicising electrician. It must, of course, be borne in mind that the electrical system cannot furnish data as to the quality of impurities, it can only give an accurate indication of the quantitive degree of impurities present. This, however, is all that the electrician could expect, or needs. For, as Mr. Digby briefly and fairly sums up, the determination of the electrical conductivity of liquids offers to the engineer:

"(*a*) The knowledge as to when the analyst should be called in to report upon the nature and probable effect of a change in the constitution of a boiler feed water indicated by the conductivity tube and conductance meter. (*b*) The knowledge as to whether condensers are leaking, and amount of the leakage, so that the date for overhaul (immediate or remote) can be promptly settled. (*c*) An exact determination of the amount of priming arising in any type of boiler under any defined conditions of load, water-level, or nature of water in the boiler. (*d*) The control of oil eliminating plants, preventing the inadvertent addition of injurious constituents to the boiler feed. (*e*) The control of water softening plants." This is a great gain, and we should also remember that Mr. Biggs demonstrated before the Faraday Society that using a modified instrument the specific resistance of oils. We have here, therefore, a practical means whereby the efficiency at central stations may be maintained at a high level, and economy effected. Anything tending to these *desiderata* is worth having.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "The Editor, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

PATENTS IN HOLLAND.

Sir,—The following is an abstract of the text of the New Patent Act which has just passed the Second Chamber in Holland, and will almost certainly become law before the end of this year:

A patent must be for a new product, a new process, or a new employment of a product or of a process. In the word "product," however, a machine or apparatus is included, as these are the product of human workmanship. Also a chemical product is included in this if it be not known before. The invention, however, must be an industrial application. A patent for a new process covers the article itself, provided it has been obtained by that process. The first applicant for a patent is held to have the right to it, whether he be the inventor or not, but inventions to be validly patented must not have been publicly described or known in any way so that they can be readily used by experts in the art. An invention, however, protected by anyone in any countries of the convention for the protection of industrial property, is *per se*, protected by that person in Holland for one year from the date of the first protection abroad, provided the patent be applied for within that year. If an employee of another person, firm, or company, take out a patent, he must mention the name of his employer and the nature of his employment, and certain other particulars, and the employer can apply to have the patent granted to him on his paying a reasonable compensation to the inventor, and if this cannot be agreed upon, the Board of Examiners, if desired by the inventor, will decide. The rules as regards international exhibitions, patents of addition, and the rights of an inventor are much the same as in England, except that a man who has begun to use the invention privately before the date of the patent, has the right to continue its use in his own industry provided he notifies the Patent Office within six months of the date of publication of the invention, giving satisfactory proofs thereof, and such prior use does not make the patent invalid. Patents can be opposed within six months of their being allowed and thrown open to public inspection on the ground that the invention, or part of it, has been taken from the opposer by the opponent, or that he is a joint inventor. There is a compulsory clause obliging inventors who have not worked their inventions sufficiently in the realm by the end of three years to grant licenses to other parties on satisfactory terms; also patentees of improvements on the invention can obtain compulsory licenses at reasonable rates, but the patentee of the improvement must in such case license his invention to the inventor. The Board of Examiners decide the terms of the licenses in each instance. There are annual taxes, gradually increasing each year. Patented articles must be marked in such manner as the Patent Office may appoint. Infringements and false marking are both civil and criminal offences, and entail damages. Within five years of the date of the patent the patent must be worked *bona-fide* in an industrial establishment in the realm, otherwise the patent can be revoked. A patent can be extended on application to the Dutch East Indies, Surinam and Curacao.

Yours truly,
Wm. P. Thompson & Co.,
Chartered Patent Agents.

6, Lord-street,
Liverpool, July 11, 1910.

RUSSIAN ELECTRICAL EXHIBITION.

We are informed that the International Exhibition of the Application of Electricity to Railways, which we announced was to be held at St. Petersburg in August of this year, has been postponed to April 15, 1911, in order to coincide with the celebration of the 75th year of the Russian Railways. This celebration will also be under the auspices of the Imperial Russian Technical Society. The Exhibition will remain open from April 15 to June 28.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149. Fleet Street, London, E.C.

CONTRACTS.

BOROUGH OF CHELMSFORD.

TRINITY ROAD COUNCIL SCHOOL.

TO LIGHTING CONTRACTORS.

The Borough of Chelmsford Education Committee invite ALTERNATIVE TENDERS for the EXECUTION of the following SUBSIDIARY WORKS in connection with the TRINITY ROAD COUNCIL SCHOOL, which is now in course of erection, viz. :—(a) SUPPLYING and FIXING WIRING for LIGHTING by ELECTRICITY; (b) SUPPLYING and FIXING PIPES for LIGHTING by GAS.

The plans of the School Building may be inspected until July 28 at the Office of the Architect, Mr. W. H. Pertwee, the Institute, London-road, Chelmsford, from whom all particulars may be obtained.

The Contract for the erection of the School Building has been let to Messrs. Henry Potter & Son, of Chelmsford, and the person whose Tender is accepted for the before-mentioned works will be, and act as, sub-contractor to, and will be paid by, that firm.

Tenders (which must be on forms to be obtained from the Architect), together with detailed schemes and specifications, must be enclosed in sealed envelopes, endorsed "Springfield School," be addressed to me and delivered at my office by not later than August 31.

The Committee do not bind themelves to accept the lowest or any Tender.

W. SMITH,
Town Clerk.

Municipal Offices,
16, London-road, Chelmsford.
July 14, 1910.

URBAN DISTRICT OF FINCHLEY.

ELECTRICITY WORKS.

EXTENSION OF PLANT.

The Council of the above-named District are prepared to receive TENDERS for the Supply of :—

One WEIR or HALL TYPE OF BOILER FEED PUMP capable of supplying 5,000 gallons of water per hour, steam pressure 160 lbs. per sq. in.

Further particulars, general conditions and form of Tender may be obtained at the Offices of the Electrical Engineer to the Council (Mr. E. Calvert), Electricity Works, Squires-lane, Finchley, N., on payment of One Guinea, returnable on receipt of a bona-fide Tender.

Sealed Tenders, marked "Extensions, Electricity Works, Section L11.," to reach me, the undersigned, before 12 noon on Thursday, July 28, 1910.

The Council does not bind itself to accept the lowest or any Tender.

E. H. LISTER,
Clerk of the Council.

Council Offices,
Finchley, N.
July 13, 1910.

PATENTS.

S. SOKAL, Chartered Patent Agent,

AND

Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.

55, CHANCERY LANE, LONDON, W.C.

DYNAMO-ELECTRIC GENERATORS. No. 16729 of 1906.

THE PATENTEE is desirous of arranging by license or otherwise, on reasonable terms, for the manufacture and commercial development of the invention in this country. Address HERBERT HADDAN & Co., Patent Agents, 31-32, Bedford-street, Strand, London, W.C.

TENDERS ACCEPTED—Home.

BOLTON.—The Bolton Town Council have accepted the tender of the Brockie-Pell Arc Lamp Company for the supply of single-phase transformers, during the next twelve months, in sizes up to 15 K.V.A.

ERITH.—The Urban Council have accepted the tender of Messrs. Fraser & Chalmers, Ltd., Erith, for the supply and erection of a "Robeson-Bettington" boiler complete at the price of £1,875 and a 1,000 kw. "Ratteau" impulse turbo-alternator (Siemens' alternator) complete at the price of £4,753 be accepted, subject to the company giving a guarantee for the maintenance of the boiler for a period of five years from the date of the contract in terms to be approved by the clerk and the engineer. It was also resolved that the tender of the British Westinghouse Electric and Manufacturing Company, Ltd., for the supply of a new stator to replace defective plant at the price of £264 be accepted.

LEEDS.—The Corporation have accepted the tender of the Electro-Mechanical Brake Company, Ltd., for the supply of magnetic track brakes, at the sum of £1,020, and platform gear switches and resistances at £234.

CONTRACTS OPEN.

HOME.

BARNET.—Guardians.—A, dynamos, motors, &c.; B, battery; C, wiring. Specification (£5) from Clerk, 12, High-street. July 26.

CHELMSFORD.—Borough Council invite tenders for supplying and fixing wiring for lighting the Trinity-road school by electricity. (Particulars from the Borough Architect). August 31.

DUBLIN.—Corporation invite tenders for the supply and erection of transformers. (Particulars, 21s., from City Electrical Engineer). July 16.

LEEDS.—Corporation invite tenders for supply of copper lamps, lamp pillars, lamp furniture, pillar lamp irons and carriages, wall bracket irons, sheet copper and copper tops, and glass. Particulars from Superintendent of Street Lighting, Springwell-street Depôt. July 20.

LONDON.—London County Council invite tenders for the supply and delivery of 4,800 steel tyres for driving wheels and 1,600 steel tyres for pony wheels for electric tramcars. Particulars from the Chief Officer, London County Council Tramways, 62, Finsbury-pavement, E.C. July 26.

LONDON.—The London County Council invite tenders for the roadwork and platelaying required for the construction, on the underground conduit system, of the Council's authorised tramway in Battersea Bridge-road and Beaufort-street, Chelsea, and over Battersea Bridge, and for the paving works of certain street widenings on the route The route is equivalent to about 2 miles of single track. The contractor will be required to use the track rails, with their fastenings, the slot rails and conductor rails, and the special work for the cross-overs, etc., which will be provided by the Council under other contracts, but all the remaining metal work and other materials will be included in the contract. (Specifications from the Chief Engineer, County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of £5). July 19.

ROCHDALE.—Electricity Committee invite tenders for supply of 50,000 tons of best gas coal, screened, unscreened, or nuts, to be delivered over a period of twelve months from September 1. (Particulars from Manager of Gasworks, Dame-street). July 20.

WALTHAMSTOW.—Urban Council invite tenders for six double-deck roof covered electric tramcars with magnetic brake equipments. Specification (40s.) from Tramway Engineer, Priory-avenue Works.

WEST HAM.—Education Committee.—Electric light installation at Silvertown school. Particulars from Secretary, Town Hall. July 18.

WHITEHAVEN.—Corporation Electricity Department. Contract No. 8. One 35 kw. single field direct current auto-converter to convert from 420 volts D.C. to 220 volts D.C; Contract No 7: Two sprinkler type mechanical stokers for Babcock & Wilcox water tube boilers. Specification (£1 1s.) from Borough Electrical Engineer. July 16.

OSRAM-LAMPS

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PLANT FOR SALE.

Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

PLANT WANTED.

PLATINUM UTENSILS, SCRAP, LAMP TOPS.—Best prices given by DERBY AND CO., LTD., 44, Clerkenwell-road, London, E.C. N.B.—Platinum Sold.

AGENCIES.

LIBERAL COMMISSION is offered to an energetic and capable salesman calling upon users of nuts and bolts, to introduce a Patent that will save all users 75 per cent.—Address, B.C., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

SITUATIONS VACANT.

MEN OUT OF EMPLOYMENT in all branches of the Electrical Trade should write to Box No. 20, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

SITUATIONS WANTED.

MANUFACTURER'S REPRESENTATIVE desires change; London or Provinces.—Box A., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

MOTORMAN, excellent references, 5 years' experience with St. Helens Tramway Company.—Box S., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WIREMAN, 5 years' experience; age 25.—Box T., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, aged 16, seeks engagement, Electrical Engineer. North London preferred. Intelligent, good education.—R. C., ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

ELECTRICAL MAINS FOREMAN, thoroughly acquainted with all branches of the work, both high and low tension cables laid on all systems; also knowledge of overhead and construction and permanent way. Excellent references.—G. P., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

APPLICATIONS for Appointments effectively arranged, ensuring favourable consideration. Numerous unsolicited testimonials. Expert advice. Write now.—HERBERT GREATOREX, Beechwood, Matlock.

JUNIOR SUB-STATION ATTENDANTS WANTED by three-phase London Railway; preference given to students of Polytechnic, Northampton and other Institutes. State age, experience and salary required, to Box 21, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WANTED, STOREKEEPER, accustomed to Electric Tramway, Lighting and Wiring Material and pricing of same. Salary 30s. per week. Only experienced man and good book-keeper need apply.—Box 22, c/o ELECTRIC ENGINEER, 149, Fleet-street, London, E.C.

UNIVERSITY OF GLASGOW.

DEPARTMENTS OF ENGINEERING, MINING, AND NAVAL ARCHITECTURE.

PROFESSOR OF ENGINEERING	Archibald Barr, D.Sc., M. Inst.C.E., M.I.Mech.E.
PROFESSOR OF NAVAL ARCHITECTURE	J. Harvard Biles, LL.D., D.Sc., M.I.N.A., M.Inst.C.E.
PROFESSOR OF MINING	Charles Latham, M.I.M.E.
LECTURER ON ENGINEERING DRAWING AND DESIGN	Harry Bamford, M.Sc., A.M.Inst.C.E.
LECTURER ON ELECTRICAL ENGINEERING	John S. Nicholson, B.Sc., Whit.Sch. A.M.I.E.E.

The SESSION commences on October 17th, 1910, and ends on March 23rd, 1911. Students usually spend the summer months in practical work, thus receiving their training on the Sandwich system.

Prospectus of the Courses for the degrees of B.Sc. and D.Sc. in Engineering and Syllabus of Classes will be forwarded on application to the

ASSISTANT CLERK,
Matriculation Office,
The University, Glasgow.

OVERSEAS.

CAIRO.—Department of the Interior.—Electric lighting plant for Assiut. Particulars from Secretary, July 30.

MELBOURNE.—H.M. Trade Commissioner for Australia (Mr. C. Hamilton Wickes) reports that tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on August 30, for the supply of (1) electrical sundries (Schedule No. 303), and (2) insulators, wire, and sulphate of magnesia (Schedule No. 304). A deposit will be required with each tender. Local representation is necessary. Copies of the specification and forms of tender, etc., can be obtained, and preliminary deposits paid, at the office of the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W. Copies of the conditions and form of tender may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

PRETORIA.—Transvaal Post and Telegraphs.—Two miles of 64-conductor switchboard cable. (Part. (L.), Agent-General, 72, Victoria-street, Westminster, S.W.) July 7.

PRETORIA.—The "Union of South Africa Government Gazette" of June 10, notifies that tenders are invited by the Administration of Posts and Telegraphs, Transvaal, up to noon on July 27, for the supply of two miles of switchboard cable, 64 conductor. Tenders, marked "Tender for the supply of Switchboard Cable," should be addressed to the Chairman of the Tender Board, P.O. Box 376, Pretoria. In the event of shipment of either of the above-mentioned stores by steamer from any port of the United Kingdom, or from ports on the Continent of Europe between Bordeaux and Hamburg (both inclusive), the contractor will be obliged to ship the goods by any line or lines of steamers with which the Administration may have made arrangements for the conveyance of the Administration's material and stores. Information in regard to this can be obtained on application to the High Commissioner for South Africa, 72, Victoria-street, London, S.W. It will be observed that the limited time for receipt of tenders will hardly permit of their being despatched by post, and the above intimations are therefore only of use to those firms having agents in South Africa whom they can instruct by cable.

THE HAGUE.—Post and Telegraph Department.—Installation and improvement of telegraph lines along the railways Zutphen-Hengelo-Glanerbrug and Hengelo-Springbiel and Zutphen-Winterswijk. July 27.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ABERDEEN: Wilsons & Walker, architects, 131A, Union-street. Sausage Factory for Northern Company Operative Company, Ltd.

ACTON: There is a proposal to erect a Parish Hall, and about £500 has been promised towards the scheme.

ASHTON-ON-MERSEY.—J. O. Barrow, Borker's-lane. Wesleyan Chapel.

BELFAST: A. Ferguson, architect, Scottish Provident Buildings, Belfast. Re-building Church.

BELFAST.—The Senate of the Queen's University purpose to spend £52,000 on an enlargement of the present buildings.

BENTLEY: J. W. Wilson, architect, Goldthorpe, near Rotherham. Eight Houses.

BRIGHTON: J Simpson & Son, surveyors, 16, Ship-street, Brighton. Alterations and additions to Municipal School of Art.

CARDIFF.—Director of Education. School for 1,094 children at Canton.

DEWSBURY: Holtom & Fox, architects, Corporation-street, Dewsbury. Council School at Batley Carr.

GLASGOW: Walker & Ramsay, architects, 108, Douglas-street, Glasgow. Concert Hall at Scottish Exhibition of National History, Art and Industry, 1911.

HARROGATE: W. Gilbee Scott, architect, 25, Bedford-row, London. Large School and Boarding House near Harrogate.

HEIGHINGTON: Kitching & Lee, architects, Houndgate Chambers, Darlington. Alterations to Chapel and Schools.

KIDDERMINSTER: Education Office, Worcester. High School for Girls.

LEEDS: Education Department, architects' Section, Leeds. Armley Park and East Leeds Special Schools.

LOSTWITHIEL: A New Town Hall is to be erected.

LONDON, W.C.: Bertie Crewe, architect. New theatre for Messrs. W. & F. Melville, in Shaftesbury-avenue, facing Endell-street.

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NEWLYN.—Perkins & Caldwell. Bank buildings for Barclay & Company, Ltd.

NORTHAMPTON: Messrs. M. Dode & E. Compton, proprietors of the Northampton Opera House, are about to erect a large Music Hall.

ST. GERMANS: J. Lansom, architect, Liskeard. Town Hall.

TORQUAY: Watson & Watson, architects, 36, Torwood-street, Torquay. Laundry Building at Torbay Hospital.

WINCHESTER.—A school for 330 children is to be erected by the Education Authority.

NOTES.

A New Controller.

A notable improvement has been introduced in the controller shown in the accompanying illustrations. It has been carefully developed, and is now manufactured at the Witton Works of the General Electric Company, Ltd. The aim of the designer has been to produce an article thoroughly sound mechanically as well as electrically, with all parts accessible and to be easily dismantled and reassembled. The first illustration shows the controller in the working position with only the cover removed. Attention is called to the large blow out coil, the extra heavy Uralite sparking divisions and the strong panel and cam wheel. Figure 2 shows the controller with the blow out coil and sparking divisions swung out. It swings quite clear from the controller and leaves absolutely every part and every screw easily accessible for either inspection

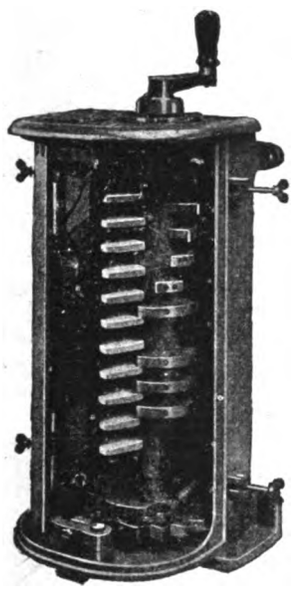

FIG. 1.—SHOWING G.E.C. CONTROLLER IN POSITION WITH ONLY COVER REMOVED.

or repair. This illustration also shows the special ebonite clamps which are provided to hold the blow out coil leads in position, which in many controllers are left unsupported, forming a constant source of trouble. Attention is also drawn to the ease with which the controller can be wired up. The Arminals are directly opposite the cable entry holes, and are provided with sweaters, the same external diameter as the cable. Figure 3 shows the component parts of the dismantled controller. The case is made of cast iron and is machined where necessary. It is provided with a sheet iron cover, held on with the usual fly-nut fastening. On the back of the carcass near top and bottom two projections with V-shaped machined slots will be noticed. These carry the finger system, which consists of a square mild steel bar, fitting into the V-shaped slots of the above-mentioned projections, and is fixed to same with two screws at each end. This bar is micanized all over except at the extreme ends, and the finger carriers, which are wrought iron stampings, are clamped to the micanized part. They carry

VULCANITE
ALL SPECIAL ARTICLES QUOTED FOR ON RECEIPT OF SAMPLE, SKETCH, OR SPECIFICATION.
F. CARSON & EVANS.
3A Fenchurch Buildings, LONDON, E.C.
EBONITE

Ammeters
Voltmeters
The Latest and Most Novel Patterns.
The Best and Cheapest in the End.
For Lists and Particulars apply to
The Leysner Electrical Instrument Coy.,
12, Lime St., LONDON, E.C.

HEATHMAN FIRE SETTLER
Works with Chemicals
28/-
Charges 4/6 for 3.

HEATHMAN FIRE ESCAPE Co,
Parsons Green, LONDON, S.W.

THE ELECTRICAL ENGINEER REPRINTS.
New Series No. 1
JUST PUBLISHED.
"LIGHTNING CONDUCTORS,"
By ALFRED HANDS, F.R.Met.S.
Author of "Scientific Protection," "A Guide to the Proper Application of Lightning Conductors," "Lightning and the Churches," etc.
PRICE THREEPENCE.
Post free, Threepence Half-penny.
THE ELECTRICAL ENGINEER, LTD.,
149, Fleet Street, London, E.C.

WANTED TO PURCHASE from Electric Lighting Companies and Electrical Engineers. — **Dynamos, Motors, Cable, Wire, Instruments,** and every description of Electrical Material, also Manufacturers, **Surplus Stocks.** The bulk being for re-use, High Cash Prices can be paid.—A. VEREY & Co., Dover. Telegraphic Address: "Verey, Dover."

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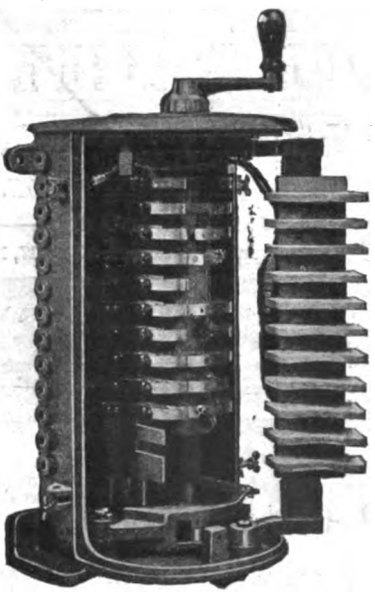

FIG 2.—SHOWING THE CONTROLLER WITH THE BLOW-OUT COIL AND SPARKING DIVISIONS SWUNG OUT.

on their upper end the contact fingers, and on the lower cable terminals. The spark shield between the finger bar and drum is also attached to the finger bar by means of small angle pieces which clamp under the fixing screws at both ends. Each finger can be removed separately without taking the finger bar out of the controller. The drum consists of four castings clamped to a micanized square mild steel shaft, not less than two sets of screws secured with lock-nuts being used on each pair of castings. The castings have projections, which are turned true when in place on the shaft. The interchangeable copper contact segments are screwed to these projections. The two ends of the square shaft are turned round. To the lower end the cam-wheel is keyed which is kept very strong, as is also

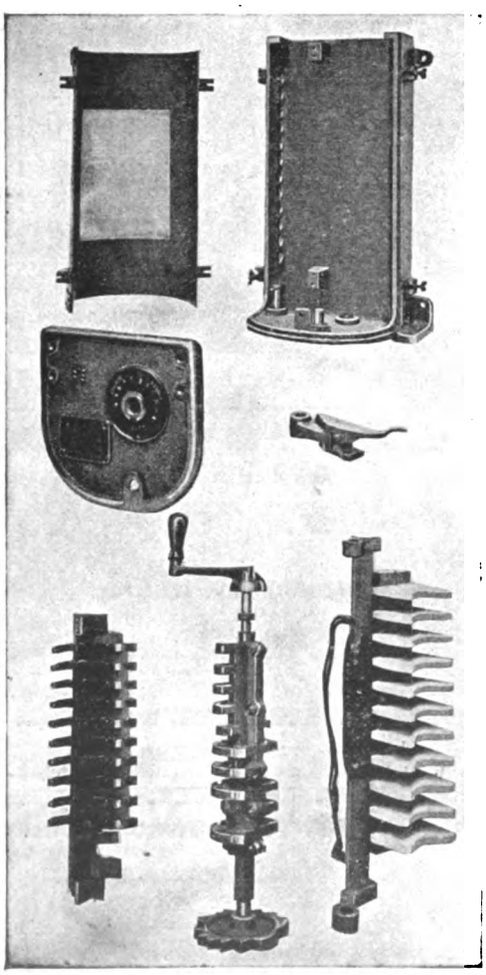

FIG. 3. - SHOWING THE COMPONENT PARTS OF DISMANTLED CONTROLLER.

the panel which can be seen above the cover in the illustration. It is most important that an ample factor of safety be allowed in these two parts and also in the panel spring as the safe working of the controller and therefore of the motor and what it drives entirely depends on these parts. The handle, as will be seen, is cup-shaped, to prevent rain-water from filtering through the bearing of the shaft should the controller be used in the open. Provision is also made to prevent the handle being taken away in any but the "off" position. The top plate is of cast-iron, with polished brass fittings. The pole-piece, which carries the amply-dimensioned blow out coil, has fitted to its face and reaching over the whole length of the drum a heavy piece of fireproof insulating material. The sparking shields of Uralite are cemented into slots in this piece, no screws being employed, and therefore a breakdown to earth due to the splitting of one of the Uralite pieces is made practically impossible. The controller is suitable for motors up to 50 b.h.p. on 500 volt circuits, or for a maximum current of 75 amps. on lower voltages. It can be supplied with the leading-in holes for the cables arranged either on the left or the right-hand side.

"Nesdrum" Water-Tube Boilers.

Messrs. Richardsons, Westgarth and Company, Ltd., of Middlesbrough, have recently received an intimation from the Secretary of the Admiralty informing them that their name has been placed on the Admiralty list of approved water-tube boilermakers. Before coming to this decision, Messrs. Richardsons, Westgarth and Company's "Nesdrum" vertical-tube boilers were most carefully examined by Admiralty inspectors.

OSRAMS IN GLASGOW.

Unquestionably one of the finest examples of street illumination by metal filament lamps, is to be found in Glasgow, where by their highly successful trials "Osram" lamps are in favour for the lighting of important positions.

A walk down Queen-street—a wide, busy and principal thoroughfare, will convince even the most sceptical (if any such remain) that the metal filament lamp has more than secured its position in the field of "public illuminants."

QUEEN STREET, GLASGOW.

Its economies have all along been appreciated, and now the fragility of filament is no longer a nightmare, it supplies the most fitting of all weapons with which to fight the gas bogies. Let there be war to the death!

The remarkable results in Queen-street are obtained by means of 30 Osram lamps, *i.e.*, sixteen 100 watt and fourteen 55 watt; all for 260 volts. These are arranged on 23 posts and have been installed since April 1, burning just over 400 hours up-to-date.

None of the lamps have failed, and the candle-power has in no way diminished.

This installation furnishes yet another proof of the strength of the Osram filament now supplied.

Queen-street is a main thoroughfare, and heavy traffic passes up and down unceasingly morning, noon and night.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Novocastrians are considerably disappointed at the uncompromisingly negative reply of Mr. McKenna to the deputation which addressed him on the subject of utilising the Jarrow Slake as a site for a repair base for the Navy. It had been hoped that the influential nature of the deputation, and the arguments which they had to advance, would have met with other results. Although the alternative—the floating docks now in process of construction to the order of the Admiralty—are admitted to be good in their way, it is urged that something more substantial is required in view of the fact that Rosyth will not be completed for five years. In the meantime the local press is pointing out that the existing docks at Hebburn should be brought strongly to the attention of the Admiralty, as suitable for its repairing work, inasmuch as they have been entirely neglected in this respect. Messrs. Armstrong, Whitworth & Company have made repeated use of these docks in connection with the largest battleships they have built, such as the "Minas Geraes," the "Invincible," and the "Kashima," so that the Admiralty might do much worse than place some of its repairing work on the Tyne.

The Harbour of Blyth.

Apropos of my notes concerning Blyth in a recent issue, it is interesting to record that members of the North of England Institute of Mining and Mechanical Engineers have during the past week inspected the numerous works in progress, upon the invitation of the River Blyth Commissioners. Among those present were such well-known mining men as Mr. W. Cochran Carr, Mr. Philip Kirkup (the local president of the Association of Mining Electrical Engineers), Mr. T. E. Forster (the president of the Mining and Mechanical Engineers), and Mr. J. Simpson, Mr. J. Watt Sandemann, the engineer to the Commissioners, assisted in receiving the visitors, and explained the engineering features, such as the railway accommodation and other points mentioned in my previous notes.

Newcastle Corporation Tramways.

The scheme outlined in my previous notes concerning the carrying of parcels upon the Newcastle Corporation Tramways has now gone a step further and received definite shape. In the proposals to be laid before the Tramways Committee by the sub-committee dealing with the matter, the principal points of recommendation are as follows:—(1) A charge to be made upon all parcels of merchandise and luggage excepting personal luggage up to 28 lbs. per passenger. (2) The charge to be 1d. per parcel irrespective of distance. (3) No person under 14 travelling with such parcels to pay less than 1d.; this being an exception to the rule as to ½d. fares for children under 14. (4) No parcels to be accepted for carriage upon the tramcars without accompanying passengers. (5) The scheme to come into operation at the end of the present month. It is estimated that, even exempting personal luggage as above defined, the annual income will be of the nature of £2,000.

Shipbuilding on the Tyne.

There is no doubt that one of the chief Tyneside industries, that of shipbuilding, is rapidly recovering its former volume. It is stated that Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend, are to build another Cunard liner, to be called the "Laconia," as a sister ship to the "Franconia," which is now nearing completion. Messrs. Armstrong, Whitworth & Company, Ltd., have also obtained an important order for a war vessel for the Brazilian Navy of a larger than Dreadnought size. It is stated that its displacement will be 32,000 tons, and will have twelve 14-in. guns, and twenty-eight 6-in. and 4-in. guns. This places her fighting power at beyond any vessel built at present. There have also been a considerable number of launches of general merchant vessels, and all the yards on the Tyne appear to be busy. There is, however, a complaint going round that, while the work is coming in, the prices obtained for general merchant work are cut. So far as wages are concerned, therefore, Tyneside is getting prosperous, and the activity of the shipyards is good for the supply of electric power. The price-cutting, however, makes it rather difficult for the suppliers of electric fittings and machinery, who are suffering, so it is said, from cheese-paring tactics in one or two directions.

Railway Development.

The work in connection with the strengthening of the North-Eastern Railway Company's engineering departments at Darlington, which I foreshadowed some time ago in these columns, is proceeding fairly rapidly. The engineering shops which are now being built are approaching a stage where the finishing touches are being considered, and a contract of some magnitude for flame arc lamps for the lighting of these shops has just been given to the Gilbert Arc Lamp Company. It is anticipated in some quarters that before long the "centre of gravity" of the North-Eastern Railway engineering departments will be moved from Gateshead to Darlington.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The ratepayers of Birmingham were invited last week to view the Electric Supply Station in Summer-lane. The extension of the station authorised by the Council some two years ago is now nearing completion. The new chimney stack has reached nearly half its intended height, and is expected to be completed about September next, when it will match in dimensions the original stack which rises to a height of 230 ft., with an inside diameter of 15 ft., and required for its construction 750,000 bricks. The additions to the machinery include two A.C. and two D.C. generating sets, the former supplied by the British Westinghouse Electric Company, and the latter by Dick Kerr & Company. The converter plant has been doubled, two 500 kw. rotary converters by the British Thomson-Houston Company having been added. Eight new water tube boilers have been put in and four new Green's economisers. Four steel cooling towers have also been erected, and among other incidental work there has been an enlargement of the canal basin to accommodate the increased deliveries of coal.

Increasing Demand.

Consumption of current here has increased during the last quarter in all departments except for tramways, and some of the high tension consumers are so far satisfied with the use of electricity that they are putting in additional plant. There is a growing disposition on the part of other departments of the Corporation to make use of electricity. For instance, the new baths which were opened in the Nechells district last week have electric lighting throughout, and electric lighting is being gradually extended to the other baths in the city. Both the Moseley-road and the Kent-street Baths are wholly or largely lighted by electricity, the Cottage Baths at Coventry-street are so lighted, and a substantial beginning has been made with similar provision at the Monument-road Baths. Two or three new electric theatres are being erected in the city as the result of the success of those already opened, while the Aston supply has secured a new customer in the shape of an electric theatre at Aston Cross. A fine building erected for

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the Aston Unionist Labour Club has undergone reconstruction for this purpose, and the entertainments will be on a somewhat ambitious scale.

The Art of Main Laying.

Much trouble has been experienced at Hereford owing to the way in which the mains were originally laid in the High-street, High Town, and Widemarsh-street. The insufficient filling in of the troughing with bitumen caused damp to attack the indiarubber insulation, while the bad tinning of the copper wire fans set up sulphating of the copper. A good deal of work has been done in the way of testing for, cutting out and replacing defective portions, and it is hoped that the trouble is now at an end. The failure of the section boxes owing to their faulty construction is another difficulty that has had to be met and overcome, while the storage battery at the works has been entirely reconstructed and renewed, bare copper on insulators replacing the rubber covered cable connections. Four new panels of switchgear have been added to the main switchboard. The whole of this work has been done by the station staff, and paid for out of revenue. Owing to these special expenses the department has not been able during the past 12 months to show a balance of income over expenditure, but as these charges are not likely to recur, a much more satisfactory trading result may be expected for the current year. The number of consumers both for power and for lighting has increased largely during the last six months, a result attributed partly to an exhibition held by the department in May last. There has been a decrease in the number of lighting units sold, but this has been more than counterbalanced by the increase in the power units, the net increase for the year being 56,463 units. The increase in sales during the latter half of the year exceeded £500, notwithstanding the decrease in lighting sales, which was due to the increasing use of metallic filament lamps. During the year, 6,509 lamps were added, and 200 h.p. in motors as against 3,107 lamps and 40 h.p. in the preceding 12 months, and there are a great many new consumers for lighting and power whose consumption did not come into last year's accounts. Sanction has just been obtained for a loan of £3,500 for extensions of the works and mains.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

The Manchester Gas and Electricity Committees, which have sometimes been inclined to misunderstand one another, are now mutually endeavouring to look at things more broadly. This was announced in the City Council last week by both Committee chairmen, and Mr. Alderman Walker referred to negotiations which were taking place between the two Committees with a view to removing whatever causes of friction existed between them. They had arranged for a joint conference, and as a preliminary, the officials had met and cleared a good deal of ground.

Oldham Tramway Makers.

The Oldham Tramways Committee are much annoyed that Manchester have decided to make Stevenson-square the city terminus for Oldham cars, instead of Piccadilly, which is the present terminus, and only one minute walk further into the city. At present it is no uncommon thing to see about 20 cars in a line in Piccadilly, and as about 3 important routes turn out in a very short length, there is continual delay in moving points. By using Stevenson-square, Manchester will save this congestion and passengers will probably find the new arrangement quicker. Some Oldham Councillors, however, thought the through running agreements with Manchester ought to be terminated because of Manchester's re-arrangement! Surely these worthy guardians of their borough's phantom rights have never made *le grand tour* to "Lewis's," without which the education of no South Lancashire townsman is considered finished. Wise counsels prevailed, however, and seeing that Manchester trippers to Oldham will be just as much "inconvenienced" as Oldham visitors to Manchester by the new terminus, the matter drops. Thus was the city of Manchester spared by the County Borough of Oldham. At this same meeting, Oldham decided to extend the tramway line from Moorside to Grains Bar, the Borough boundary on the east side. There was a certain amount of opposition to this proposal, but it was passed over. The new line will take the people of Oldham out to the moorlands, and should prove very popular.

Bury Developments.

Bury, as will be remembered, is putting down a second generating station. A new site has been acquired, by the railway, adjacent to the river and enough to allow of very considerable extensions when these are needed. The buildings are already erected and the foundations are now being put in. Work is being pushed on and it is hoped to have the plant running by November next. To commence two 2,000 kw. turbo alternators are being installed, to give a three-phase supply at 6,600 volts 50 cycles. The turbines are of the Zollhy type by Busgranes, with Siemens alternators, and Clarke Chapman boilers, each giving about 25,000 lbs. steam. Steam driven air and circulating pumps by Chas. Walmesley & Co., Bury, are being installed. Coal will be dropped direct from the railway wagons into the hoppers of the coking stokers, thus doing away with conveying plant. Surface condensers will be used. Ferranti, Ltd., are supplying the H.T. switch-board. The present station is away from the railway and all coal has to be carted, while for water it is dependent upon a mill lodge. For the present the two stations will generate, but it is probable that eventually only the new station will supply, the old one being used as a sub-station. With this end in view, two 500 kw. motor generators to meet developments in load are now being put down. These will be supplied with three-phase H.T. current from the new station, and will supply power to small consumers, traction and lighting loads. Large power consumers will be connected with the H.T. system and supplied direct from the new works. Power supply is developing very rapidly and during the year just ended showed 49% increase over the previous year. Most of the power is taken by engineering works, and two or three cotton and woollen mills are also being supplied. The existing plant is fully loaded, and already about another 1,000 h.p., which includes several textile mills, is waiting for a supply, equivalent to an additional 1½—2 millions units per annum. Supply is given on a tariff which gives fairly large consumers of 150–200 h.p., a price of ⅝d. per unit. At this figure consumers are quite satisfied, and say the cost is about the same as for the steam plant formerly used. For consumers taking more than 200 h.p. special terms have to be made. Although gas is cheap—about 1s. 5d. on a sliding scale for power—its effect has not been felt as a competitor for the power load. The lighting load which fell very slightly last year owing to the new lamps, is picking up again, many of the houses from a rental of £25 upwards are electrically lighted and current is only 2¾d. per unit. As the power load is growing so rapidly, nothing has yet been done in the direction of supplying cottage property with light. The tramways department have recently put meters on their cars, and the effect on the first quarter's power returns just completed show a saving of 8% in consequence.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

That the business of the Clyde Valley Company continues to grow is evident from their recent extensions both to plant and mains. At the power house at Motherwell there has just been installed a 5,000 K.V.A. Westinghouse turbo-alternator with condensing plant by Messrs. G. and J. Weir, Limited, of Cathcart. A new pump-house is also being put down with the object of pumping the water up from the River Clyde and dispensing with the present cooling towers. In the boiler house two Babcock boilers, each capable of giving 30,000 lb. of steam per hour, have been installed, together with two Green's economisers, each of 480 tubes, and induced draught. The boilers are

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equipped with motor-driven mechanical chain grate stokers. The company's extensive system of mains has also received several important additions. From the Yoker power house have been laid during the past fortnight six extra high tension cables. These cables have been led across the River Clyde to the Renfrew side of the river. For this purpose the river had to be dredged at the point in question and the cables are now safely laid 30 ft. below water in mid-channel. The new mains are partly by way of renewal, as the old cables were damaged through being struck by an anchor. The Strathclyde Electricity Supply Company, which is a subsidiary concern run by the directorate and management of the Clyde Valley Company, are busied with extensive main laying operations in the residential district of Newlands. They have already laid 1¼ miles of the network from which over 200 branches will ultimately be taken, each branch representing at least 20 lighting points. Provision is also being made for a high tension system of distribution. The houses in this district which are practically all new, have been mostly wired for electric light in anticipation of the supply which is now available.

Works Extensions.

The annual holidays have now begun on the Clyde. Greenock started last week, and Glasgow and district are on this week. The East and North of Scotland follow next week. The town of Paisley in this, as in other things, is an exception to the rule; it "knocks off" at the beginning of August. The ten days' shut-down is taken advantage of in most works for overhauling or altering plant. A large manufactory in Fifeshire is to have a considerable installation both for lighting and power put down during the next few weeks, and, although details are not to hand, it is understood that the orders for the plant and mains are as good as placed with one of the best-known English firms. Similarly, a large firm of shipbuilders near Port Glasgow are improving and adding a large extension to their electrical installation. They have had a small amount of plant in use for some years, but it has become obsolescent, and in replacing this with up-to-date machines the firm are likely to go in for a considerable installation both for lighting and power.

Tramway Possibilities.

In connection with a civic visitation the other day the Glasgow Corporation Tramways Department had tea served on board one of the cars to a party who were being taken round the city. Facetious commentators in the daily press saw all sorts of possible developments in this novel form of entertaining visitors. A busy City man might have his lunch served on board a car while he was en route to pay a business call a few streets away. A much more serious and sensible proposal is that the Tramway Department should undertake the carrying of parcels. In Glasgow there is, of course a considerable trade done between the city and surrounding district in carrying parcels, and it is remarkable that in a progressive city like this the means of transit is still the ordinary drayman's lorry, drawn by the large-limbed, slow-going draught horse in the good old style of 100 years ago. One or two small motor tricycle wagons have recently been introduced but they are regarded as striking innovations. At this time of year the amount of inconvenience to holiday-makers through the lack of a properly organised means of conveying luggage from residence to railway station must be enormous. The Corporation are not generally too scrupulous about their invasion of the province of the private trader, and it seems like sheer perversity that they should withhold this great convenience from the citizens simply to shield an antiquated survival from the beginning of the last century.

Public Services and Reviving Trade.

Both the Tramways and Electricity Departments of the Glasgow Corporation are already feeling the beneficial effects of reviving trade in the tangible form of enhanced revenue returns. In speaking to the Tramway Department accounts for the year ended May 31st last, Bailie Russell, Convener of the Tramways Committee, told the Glasgow Town Council that the Department's income for the first month of the new financial year was £6,000 to the good. Against that, however, they had several schemes in view which would be calculated to make considerable inroads into what extra income they might get. The committee had agreed to let the blind travel free on the cars, and a scheme in connection with this proposal would be brought before the Corporation at an early date. They also had a proposal for raising the age limit for half-fare travelling, increasing the wages of unskilled workers, and additional bridge accommodation across the Clyde. The very fact of the discussion of such proposals would seem to indicate an anticipated large accession to the department's drawings. The Corporation Electricity Department has also opened its new financial year with like prospects of increased business. The increase in the output last year was less than a third of the figure which the increase in the output has shown for the last three months.

Personal.

Mr. H. A. Mavor, of Messrs. Mavor & Coulson, Glasgow, while on the Continent the other day, was one of a number of passengers in a Zeppelin airship. As anyone who has followed the development of the electrical industry in Britain knows, Mr. Mavor is in his element in anything of a pioneering nature, and this is by no means either the first or the worst risk he has run in the interests of applied science.

The many friends of Mr. Abrahams, the chief engineer of the Lanarkshire County Council electricity supply station at Cambuslang, will be pleased to learn that he has secured a more lucrative appointment in Wales. There is a rumour that the Clyde Valley Company are trying to take over the Cambuslang station from the County Council, but nothing definite is settled so far.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

A new telephone which we believe has an important future has been invented by Max Reinganum, of Frieburg. It depends on using an aluminium foil so thin as to be permeable to alpha rays. This foil is placed in a powerful magnetic field, and microphone-currents are then sent through it. If instead of a secondary current a stronger but interrupted primary current is employed, the sound is very loud. Tinfoil can be used instead of aluminium foil, but the sound is then decidedly weak. Gold foil acts almost the same as tinfoil. The new telephone has the further advantage that its capacity and self induction are both remarkably small. Besides, there is no troublesome damping. Hence it is very suitable for use as a mill instrument in physical measurements. If the foil is put perpendicular to the magnetic lines of force the sound ceases so that since the position of the foil can be arranged at will, the instrument can serve as a valuable apparatus for experiments in acoustics.

Electricity versus Gas.

Georg Dettmar, in the "Elektrotechnische Zeitschrift," discusses the effect of introducing an electric power station upon the gas industry of the place. From an exhaustive study of practical results in Germany he comes to the conclusion that in places of less than 30,000 inhabitants the gas works are not hurt by the introduction of electricity. The unhindered further development of the old industry and favourable results for the new one depend largely on the price of petroleum. The increased facilities for obtaining light and power cause greater demand for both, which is good for both the rival purveyors. It is only in large manufacturing towns where cheap power and plenty of it is required that the gas companies who are at an obvious disadvantage in comparison to electric stations in the way of selling mechanical force are likely to suffer, as the power users will naturally get their light where they get their power. In towns where water power is not to be had an electric company does little or no harm to previously established gasworks.

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Police Launch on the Danube.

The Neue Automobil Gesellschaft of Berlin has just built a police launch for service on the Danube. It has proved a great success. The great difficulty in its construction was that high speed was required, while at the same time it was essential that the draught of water should not exceed 20 in. The boat is 40 ft. long, and has a four cylinder 45 h.p. motor, has easily accomplished 14 knots an hour in still water, so that it is quite able to cope with the strong currents it will sometimes have to stem.

Wireless Time Messages.

Dr. Ditzel, writing in the "Magdeburger Zeitung," explains how Greenwich time may be sent by wireless to a ship during its voyage. It is easy to determine latitude by the sextant, but longitude and therefore local time is not so easy to ascertain. It is usually worked out in the morning when the sun is rapidly changing its azimuth. Three sextant determinations of the sun's altitude in rapid succession and the chronometer reading afford the necessary data, together, of course, with the information as to the sun's declination and so forth given in the almanac. The shipmaster is, however, reduced to a dependence on dead reckoning when he cannot see the sun, a circumstance of not exceptional occurrence. In any case he must depend for longitude determination on his chronometer. Now, in spite of the perfection to which those instruments have been brought, they cannot always be perfectly depended upon, and an error of 1 min. in latitude 55° means that the ship is placed 10 miles further to the east or west than is actually the case. It has now been found possible to regulate chronometers wirelessly from a land station where astronomically controlled clocks rule the time. Time singals are now being sent in this way. The Eiffel Tower in Paris will shortly take an important share in this work, as will the Washington wireless station which is in contemplation. As regards ourselves, the station at Norddeich is intended to subserve this important purpose. Wireless time signals cannot, of course, enable the captain to dispense with solar observations, but they will enable him to set his chronometer to a second whenever that may be necessary.

Railway Electrification.

An important line in the Rhaetic Alps is to be electrified. The Engadine railways—St. Moritz, Samaden-Pontresina and Bevers-Schuls, are those concerned. The electrification will, however, not be complete before the tourist season of 1913. The power will be drawn from the Brusis station, and takes the form of a single-phase alternating current at 10,000 volts. We hear that it is confidently expected that this change will have for its sequel the electrification of all the other lines in the same neighbourhood. Another important departure will be the "Mittenwaldbahn," connecting Bavaria with Austria and making a convenient short communication between Munich and Innsbrick. It will be the first electric main line ever contemplated in Austria. It is also an emphatic testimonial in favour of electric traction the inclines to be surmounted would be economically impossible with steam locomotives, except with rack rails and speed requirements prohibit their employment. There must be banks of 1 in 28, some of which will be 12 miles long near Partenkirchen. The loads to be drawn will be reckoned at 100 tons per electric locomotive, but it is probable that heavier trams may have to be run, in which case two locomotives will be required. The power supplying current will probably be an alternating current of 10,000 volts and 25 periods, but the exact number of periods is not yet definitely settled. The generators are two turbine-driven dynamos, each giving 4,000 h.p. at 300 r.p.m.

Company Notices.

The Elektrizitatsleeferungesellschaft of Berlin, a company which owns 24 stations in various parts of Germany, sold 14,695,149 kw. hours in 1909, a large increase on the output of 1908, which was 11,271,523 only. The net profit increased correspondingly from 1,400,862 to 1,789,567 marks. The dividend will be 10% on the share capital of 14 million marks. The carry over to the present year is 141,778, that from 1908 to 1909 having been 142,547 marks.

The Continental Gesellschaft fur Elektrische Unternchmungen, Nurnberg, made a net profit of 1,515,747 marks for 1909 as against 1,418,981 marks. The dividend will be raised from 4 to 4½%.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

To the Chicago "Electrical Review" belongs the credit of publishing one of the most noteworthy articles on the telephone industry that has yet been given to the world. The fruit of six months' careful preparation and graphically illustrated by a series of striking charts and diagrams, the article presents statistics of telephone progress in every country of the globe. These statistics are carried up to the first day of the current year, when there were in existence upwards of 10 million telephone stations linked up by more than 24,000,000 miles of wire. Of this gigantic total two-thirds of the telephone stations and wire mileage belong to the United States. Of European countries Germany leads the way in the matter of telephone stations. She has over 900,000. But New York State alone possesses only 150,000 less than the entire German Empire. For number of subscribers in proportion to population the top places are Los Angeles, with 61,000 stations to 240,000 people, and Stockholm, with 58,000 stations and 340,000 inhabitants. The world's telephone investments amounted on January 1 to $1,500,000,000 (£308,219,190), and the number of telephone conversations during 1909 reached the prodigious aggregate of 19,000,000,000. The number of telephone stations per 100 of the population is shown as follows:—United States, 7·6; Canada, 3·7; Denmark, 3·3; Sweden, 3·1; New Zealand, 2·6; Norway, 2·3; Switzerland, 2·0; New South Wales, 1·6; German Empire, 1·5; Great Britain, 1·3; Luxembourg, 1·2; Hawaii, 1·2; Victoria, 1·0; Finland 0·9; Netherlands, 0·9; Paraguay, 0·9; Venezuela, 0·9; Belgium, 0·6; Argentine, 0·5; France, 0·5; Uruguay, 0·5; Austria, 0·3; Transvaal, 0·3; Cuba, 0·3; Hungary, 0·2; Italy, 0·2; Cape of Good Hope, 0·2; Natal, 0·2; Japan and Formosa, 0·1; Mexico, 0·1; Porto Rico, 0·1; Russia, 0·1; Roumania, 0·1; Spain, 0·1. Taking the principal countries of the world in their order as telephone users, the United States had at the beginning of this year 7,083,900 stations and 15,649,000 miles of wire, Germany 910,900 stations and 2,733,700 miles of wire, Great Britain 615,900 stations and 1,847,800 miles of wire, Canada 239,200 stations and 478,400 miles of wire, France 211,600 stations and 761,900 miles of wire, Sweden 171,400 stations and 205,700 miles of wire, Russia (including Finland) 155,715 stations and 280,300 miles of wire, Austria 99,500 stations and 298,400 miles of wire, Denmark 86,000 stations and 189,300 miles of wire, Switzerland 73,300 stations and 205,200 miles of wire, Japan 71,400 stations and 175,400 miles of wire, and Italy 56,400 stations and 101,500 miles of wire. With regard to the number of telephones per 100 of the population, Stockholm comes first of European cities with a percentage of 17·2, Copenhagen is next with 6·9, and then come Christiania with 6·5, Berlin with 4·8, Hamburg with 4·7, London with 2·5, Paris with 2·3, and Vienna with 1·8.

A Meter Code.

A meter code in eight sections is being evolved by the National Electric Light Association and the Association of Edison Illuminating Companies, and five of these eight sections have now been published. They cover definitions, standards, metering, specifications for acceptance of meter types, and methods of tests. Of these the last two are the most important. It is laid down that tests for accuracy shall include initial accuracy under normal conditions and unity power-factor, and effect of variations in power-factor, voltage, frequency, and temperature. Effects of external magnetic fields and of temporary overloads and short circuits are also determined. The equality of elements in three-wire meters and the independence of elements in polyphase meters are also considered. For direct current meters under normal conditions, the tolerance is 2% at full load and overload, and 3% at one-tenth load. Ten per cent. change in voltage must not affect it more than 3% at full

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load or 5% at one-tenth load. An overload of four times the rated current applied three times for 2 sec. each must not affect the accuracy more than 3% at full load or 5% at one-tenth load. For alternating current meters under normal conditions the tolerance is 1·5% at full load and one-tenth load, rising to 2% for half load and 3% for overload of 50%. The variation between unity power-factor and 75% power-factor must not exceed 2% and for power-factor one-half must not exceed 4%. Ten per cent. change in voltage must not change the accuracy more than 1·5% at full load or 2% at light load. Five per cent. change in frequency must not change the accuracy more than 1·5%. An overload of four times the rated current applied three times for 2 sec. each must not change the accuracy more than 1%. The temperature coefficient of any type of meter must not exceed 0·2% per degree centigrade. The potential drop in the field coils at full load shall not exceed 1% of the rated voltage in polyphase meters, and in direct-current and single-phase meters it shall not exceed 1·5% in meters of capacity less than 10 amperes or 0·75% in meters of greater capacity. Meters must not creep with 110% of rated voltage and shall run continuously with 2% of rated current.

The Method of Test.

Three methods of testing have been determined upon as the most desirable under existing conditions—the rotating standard method, the indicating instrument method, and the standardised resistance method. In the rotating standard method the revolutions of the moving element of the meter under test are compared with the revolutions and fractions of a revolution of a standard watthour meter during the same interval of time. A standard watthour meter for this purpose, provided with dials indicating in revolutions and fractions of a revolution of the moving element, enabling an accurate comparison to be made using a small number of revolutions, is known as a rotating standard. In the indicating instrument method, a given whole number of revolutions of the moving element is timed by means of a stop-watch, the load to which the meter is subjected being measured at the same time by means of a voltmeter and ammeter in direct current tests, or by an indicating wattmeter in alternating-current tests. The standard resistance method is a modification of the indicating instrument method, in which the load upon the meter is obtained by means of a set of resistances consuming a known value of watts at a definite voltage, which is measured by means of a voltmeter. It is recommended that at least three determinations should be made at each load, each determination covering a period of not less than 30 sec., and if the three differ by more than 1%, the determinations should be repeated.

The Photometric Standard.

Dealing editorially with the present unsatisfactory position with regard to a concrete unit of light, the "Electrical Review" of Chicago observes that such flame standards as the Vernon-Harcourt pentane lamp, the Hefner amyl-acetate lamp and the Carcel lamp burning colza oil, have met with some favour in England, Germany and France, but are not entirely satisfactory. They are all dependent upon atmospheric conditions, and even when all known corrections are made, the agreement between duplicate lamps, with oil from different sources, is not all that could be desired. The Violle standard, based on the light emitted from the surface of platinum at its melting point, would seem to be a more definite and reproducible standard, but experimental difficulties stand in the way of its adoption. The recent studies by Messrs. Sharp, Millar, Rosa and Middlekauff have demonstrated that the incandescent electric lamps used as secondary standards maintain more definite and reproducible values than flame standards. Moreover, if used at a definite wattage, the constancy of a seasoned lamp extends over a much longer period than when used at a definite voltage. By using a number of such lamps, and from time to time replacing such as show marked changes with respect to the others, a standard of light can be maintained more constant than by reference to any other primary source. Dr. Rosa is credited with the statement that a standard could be maintained in this manner for a century with an uncertainty of much less than 0·1%. Our electrical unit of resistance is defined in terms of the properties of a certain substance, mercury; yet practically it is found that concrete wire standards maintain better accuracy than can be secured by referring to the primary standard. Practically, mercury resistance standards are only referred to occasionally by some of the national standardising laboratories as a check against any possible simultaneous changes in the wire coils which are used as secondary standards. The adoption of the average value of the candle-power of a number of selected incandescent electric lamps operated at a definite wattage, as a concrete standard for the candle, would seem to give a practical standard which would be much more definite than any independently reproducible standard, which is superior only from an idealistic standpoint.

The Electric Car.

So great is the demand in this country for electric automobiles that several of the companies making this form of vehicle have had to enlarge their premises. The latest concern to increase its plant capacity is the Anderson Carriage Company, of Detroit, which is constructing a new building of reinforced concrete, three stories and basement, 304 ft. front and 80 ft. deep, affording an addition of about 100,000 sq. ft, to the seven acres of floor space available in the present buildings. The Anderson Company is now in the fourth season of its manufacture of electric cars. The 1910 schedule calls for an output of 1,500 pleasure vehicles and the possibilities are that this output will be increased. The schedule for the 1911 season outlines a production of 1,000 electric trucks, ranging from 1,000 lbs. upward in capacity, according to the uses to which they will be put. They will be equipped with the latest Edison batteries. One Detroit firm has already placed its order for eight 1,000-lb. trucks and two of 2,000 lbs. capacity, with delivery-wagon bodies; and by early fall the company expects to be able to deliver trucks of this type in numbers. Since its purchase last summer of the Elwell-Parker plant in Cleveland, the Anderson Company has had the largest facilities for the complete manufacture of electric cars in the United States. Every part that goes into the standard equipment of the cars, with the exception of the imported bearings and the wheels, is designed, fitted and assembled in its factories.

New Electrical Patents.

To eliminate the tendency of an alternating current locomotive to run away on light loads when the motors are designed with a torque high enough to drive the maximum load, Mr. E. F. Alexanderson has patented a device which consists essentially in superimposing on the series characteristic of the motor a shunt characteristic which limits the speed. This is attained by using a phase converter having one phase connected to a source of voltage substantially in phase with the line-voltage, or with the voltage across the inducing or compensating winding, and another phase connected to the exciting winding. Such an arrangement impresses a shunt excitation of proper phase on the exciting winding. The phase converter may be connected with one phase across the line, or that phase may be derived from an auxiliary winding on the stator in inductive relation to the inducing winding. The leakage field between this auxiliary winding and the inducing or compensating winding may be so placed as to benefit commutation by neutralising the e.m.f. generated by the exciting flux in the coils short-circuited by the brushes. In describing this patent the "Electrical World" observes that it is suggested that in locomotives which employ forced ventilation, use could be made of a polyphase induction motor for driving the blower and that this induction motor could also serve as phase converter. Polyphase e.m.f. for starting the induction motor is derived from the commutator motor.

Minimising Commutation Reactance.

Another patent issued to Mr. Alexanderson covers improvements in this type of motor, which are intended to minimise the commutation reactance. If when the shunt voltage is impressed on the armature, the exciting winding is in circuit with the inducing winding, the armature ampere-turns are in excess of the ampere-turns of the inducing winding, so that leakage fields are produced, and

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these leakage fields, when cut by the short-circuited armature coils, induce in them an electromotive force which assists the electromotive force of commutation reactance and increases its injurious effect on commutation. If the exciting winding is connected in circuit with the armature, instead of with the inducing winding, the leakage fields produced are in the proper direction for producing an electromotive force opposing that of commutation reactance, so that the commutation is improved, but the amount of these leakage fields produced by the exciting winding in the armature circuit is not always great enough wholly to neutralise the effect of commutation reactance. The method consists in arranging the inducing or compensating winding so as to produce excessive flux at the pole tips. With this arrangement, the total ampere-turns of the armature, which are uniformly distributed, may exceed those of the inducing winding and yet the inducing winding is stronger at the pole tips where commutation occurs.

Trolley System Unification.

A proposition is likely to be carried to organise a New York State company to supplant the International Traction Company as the holding company of the trolley stysem of the Niagara Frontier. The prospectus published by the committee of bondholders provides that should the re-organisation plan be approved bondholders surrender their present bonds for bonds of the new company in the ratio of 10 to 8, par value, or surrender their bonds for cash at 70%, with interest, which is better than the market price of 64½. The International Traction Company formed in 1899 owns the stock of the International Railway Company which was formed in 1902, by the incorporation of the street-railway line of Buffalo, the lines to and in Niagara Falls, Tonawanda, Niagara Falls and Lockport, the lines on the Canadian side of the river from Niagara Falls to Chippawa and Queenston, and the two bridges connecting the lines across the river. The united length of the lines is 374 miles and the stock issued is $10,000,000 par value and $5,000,000 preferred, par value, which is deposited with the trustee of the company's collateral trust mortgage. The common stock has never paid a dividend and the preferred only once or twice.

Current Items.

The 100,000-volt power transmission of the Sierra and San Francisco Power Company from the Stanislaus River has been started and power is now being delivered in San Francisco to the United Railroads regularly. This power is being used at the Bryant Avenue, Geneva Avenue and Millbrae sub-stations, being all 60 cycle current at 12,000 volts.

A 4,700 ft. dam, with 4,400 ft. of spillway is being built across the Mississippi River at Keokuk, Iowa. The dam will be built of re-inforced concrete, with a height of 37 ft. and a base of 43 ft. The water thus diverted will drive 30 turbine-units consisting of double waterwheels and generator. The ultimate development will be 200,000 h.p.

The magnitude of the central electric station industry in the United States in the census year 1907, as compared with the census year 1902, and the growth during the intervening five-year period are shown in the census bureau's special report just published. In 1902 there were 251 railway companies that furnished electricity for light, power and other purposes. In 1907 the number had grown to 330. In 1902 the annual output of all electric stations and electric railways amounted to 4,768,535,512 kw. hours. The increase in 1907 as compared with 1902 was 122·7 per cent. The number of commercial and municipal plants increased from 2,620 in 1902 to 4,714 in 1907. The industries in 1907 represented an outstanding capitalization of $6,200,746,753.

The Union Pacific shortly will employ wireless telegraphy in its regular work of train operation. The company has had Mr. F. H. Millener, its experimental engineer, experimenting along that line for several years and now it is ready to make practical application of his work.

The Electric Storage Battery Company has secured the co-operation of central station companies throughout the country and the leading electric vehicle manufacturers for the purpose of conducting an extensive combination campaign, utilizing for this purpose pages and double pages in the leading monthly and weekly magazines and periodicals. The company has found that the central stations have awakened to what the electric vehicle means to them in the sale of current, while the electric vehicle manufacturers also realize the advantage to be gained by flooding the public with a general publicity exploiting the electric automobile.

Mr. B. L. Burrows, president of the company which is building the new monorail line between Bartow Station on the New Haven Railroad and City Island, hopes to have cars running before the end of July. Construction work has been somewhat delayed by the continuous rainy weather, but all the grading has been completed, and the road is being ballasted. A portion of the superstructure has also been built, and the guide rails and feed wires are being put into place. Only that portion of the road is being constructed now from Bartow to the bridge between Pelham Bay Park and City Island; the section running through the streets of City Island will not be built until later. Mr. Burrow says that on the section that will be completed in July, although it is only about 7,000 ft. long, he expects to be able to show a speed of 80 miles an hour.

The Newspaper Scientist is to the fore again. There is no known method of concealing anything from him. In the field of science he is a perfect sleuth, pinker than Pinkerton, and more Holmesian than Sherlock. Subjoined is his latest effort, which is now going the rounds of a too trustful American newspaper press:—"When a telegraph wire is broken or damaged, say, several hundred miles away, how does the operator, sitting in his office, know exactly where the accident occurred? The explanation is simple. It requires, as every one knows, considerable force to send electricity through a wire. The longer the wire the greater, of course, must be the force required. This force is measured in units, called by electricians 'ohms.' Let us suppose that a wire between a New York office and a point 200 miles away has broken somewhere. The telegrapher knows that when the wire was intact there were required, say, 2,800 ohms to facilitate the current, or 14 ohms per mile. He now finds that he can send current with only 700 ohms. Dividing 700 by 14, he finds that the break in the wire is 50 miles from his end." You see how simple it all is?

EDUCATIONAL.

L.C.C.

On December 21, 1909, the London County Council decided to make a maintenance grant of £8,000 to the Imperial College of Science and Technology, South Kensington. In return for this grant it secures the privilege of nominating 25 students for one year's free instruction at the Imperial College. These are now to be filled for the first time. The instruction will be of an advanced nature, and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident in the administrative county of London, and must be students at an institution aided, maintained or approved by the Council. The free studentships do not entitle the holders to any maintenance grants, but cover all ordinary tuition fees. No examination will be adopted for the final selection of the students from the applications received. The free studentships will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. It is quite possible that, in special cases, the free places may be extended to two or more years. Application should be made without delay, as entries will not be considered after July 23, 1910. Application forms (T.2/268) can be obtained from the Education Officer, London County Council, Victoria-embankment, London, W.C.

ORDER OF MERIT.—The King has bestowed the Order of Merit on Sir William Crookes, F.R.S.

OBITUARY.—We regret to announce the death of Mr. H. W. Cox, whose painful death was the result of his devoted work in perfecting X-ray equipments for medical purposes.

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Business Notes and News.

LIGHTING AND GENERAL—Home.

BIRKENHEAD.—The total income of the Borough Electricity Department for the financial year was £12,483, and the expenditure (including sinking fund contributions) £8,985. The balance was disposed of as follows: £2,962 placed to renewals account, £1,000 paid in aid of rates.

BROMLEY.—At the Council meeting it was stated that the average cost of free wired lamps with transformers was £1 2s. 3d., and that the average consumption per lamp was 9·11 units, giving a revenue per lamp of 3s. 9·55d. Mr. Dykes pointed out that this meant a heavy loss, and advocated that the whole system of charging should be re-organised.

CAMBORNE.—The solicitor to the Urban Electric Supply Company, Ltd., has served the following notice on the District Council. I beg to give you notice on behalf of the Camborne Electricity Company, Ltd., that they intend to apply to the Board of Trade for a Provisional Order giving power to the Camborne Electricity Company, Ltd., to transfer their Camborne Electric Lighting Order of 1899 to the Urban Electric Supply Company, Ltd. Dated this 27th day of June, 1910.

CARLISLE.—The Corporation Electricity undertaking last year made a profit of £3,050 net, and the gasworks a net profit of £5,513.

CLEVEDON.—The Council are obtaining a Provisional Order under the Electric Lighting Acts.

DEWSBURY.—The Education Authority are considering tenders for the electric lighting of Batley Carr Council School.

DUNDEE.—Both the Eastern and Northern Police Stations are to be lit by electricity.

EDINBURGH.—The Town Council are considering a proposal to extend the cables to the Barnton district, including Blackhall and the various centres of population in the neighbourhood. It is understood that the Committee have had numerous applications for current, and they are going to give the matter further consideration, no decision being arrived at to-day pending negotiations with the county authorities. This is one of the largest extensions in point of distance that the Committee has yet considered.

ELLAND.—At the meeting of the District Council the Local Government auditor reported that the excess of expenditure over revenue during the year on the electricity undertaking was £1,193. This had been charged to the general fund, as compared with £601 during the previous year. The reason given is the falling off of large consumers.

FAVERSHAM.—At the Council meeting the Electrical Engineer reported on the great decrease in the output of electric light to private consumers and to the public lamps, also on the reduction in expenditure as shown in the annual accounts, and attributed the saving of 9,800 units on public lighting to the conversion of 48 of the lamps from Nernst to metal filament lamps, and recommended that the remaining 53 Nernst lamps be so converted during the coming year. Resolved that the Engineer's recommendation be adopted.

GRANGEMOUTH.—At a special meeting of the Town Council plans were submitted by the Scottish Electric Supply Company showing the cables proposed to be laid and stating that the company would be able to introduce a supply of electricity into the burgh by August 15. The plans were approved.

HALIFAX.—The Corporation Electricity Department's financial report for the past year shows a total revenue of £36,329, of which £13,704 was from sale of current for private lighting (an increase of nearly £400), and £5,118 for power and heating (an increase of over £250), and £14,614 for tramway supply (a decrease of £1,280). The expenditure amounted to £20,059 (a decrease of over £2,030). The net balance was £2,157, of which £1,000 was paid in aid of rates.

HOVE.—The Lighting Committee have had before them the accounts of the corporation electric lighting undertaking for Aldrington for the year ended March 31, 1910. The revenue account shows an expenditure of £589 19s. 1d., the principal items being £328 for electricity purchased in bulk, £103 for its distribution, and £150 for management expenses. The income was £746 5s. 5d., of which £648 19s. 3d. was derived by sale of current and £58 1s. 11d. by public lighting. The balance carried to the net revenue account was £150 6s. 4d. Principal and interest charges amounted to £560 10s. 5d., leaving a debit balance of £404 4s. 1d., of which £362 19s. 9d. is provided for in the current general district rate. The only items of capital expenditure during the year were £250 15s. 5d. for mains and £43 2s. 9d. for meters. The committee recommend that mains should be extended to the north end of the Tamworth-road at an estimated cost of £245.

HENLEY.—At the Park Fête the Electrical Exhibition Tent proved a great attraction. Electrical appliances of all kinds were shown, including the new Bandy motor, manufactured under the Jacoby patents.

HORSHAM.—Last year's trading of the town's electricity department makes a creditable showing. The revenue from current supplied to private consumers was £2,907, an increase of £116, and from public lighting £1,257, a decrease of £39. After paying all outgoings, including £1,097 in reduction of capital outlay, the profit was £41 14s. 8d., as against £10 for the previous year.

LEITH.—The Corporation have decided upon the immediate installation of a 500 kw. mixed pressure turbine plant, together with a suitable condenser and cooling tower, as an extension of the town's electricity plant.

MALVERN.—The Urban Council had the consideration of revised charges for electricity. On the recommendation of the engineer, it was decided to cancel the present system of maximum demand, which was 2½ units for each 8 c.p. lamp wired, which has resulted, since the higher candle-power metallic came into vogue, in a greater percentage of the consumption being charged upon the higher rate. The engineer's recommendation was for a flat rate of 6d. per unit, less 5% for cash in 28 days, with increased discounts for larger consumers. The Council, however, decided to give the system a trial at one universal rate of 6d. per unit less 5%. This will mean practically 5% reduction to all consumers.

MANCHESTER.—The Corporation's electricity undertaking accounts for the past year are satisfactory. The revenue from sale of current for lighting and power was £247,420 (an increase of £15,800), from traction £119,348 (decrease of about £9,300), from public lighting £934 (increase of £79, and other services £6,777). The working expenses were £205,221 (a decrease of a little over £300). After allowing for sinking fund, etc., there was a net balance of £12,000, which was handed over in aid of rates.

MONAGHAN.—A scheme was before the Council whereby a local ratepayer and manufacturer offered to light the town for £100 per annum, the Council to put up its own cables and poles at a cost of £800. The present lighting, by gas, costs £201. Ultimately, however, it was decided to appoint a committee with a view to promote a municipal scheme.

OLDHAM.—The Corporation Electricity Department have canvassed the Royton and Pitsea districts with a view to extension of the electric light, with such good results that an application is likely to be soon made to the Board of Trade. The Lancashire Power Company supplies electric power in the Royton district but cannot undertake lighting.

OSWESTRY.—The Town Council have plumped for gas for street lighting. Yet the contract terms set for by the gas company are: £3 per annum for each single-burner lamp and £3 17s. 6d. for each double-burner lamp; while the Electricity Company offered to supply and maintain 44 double-burner lamps of 100 c.p. each in the main streets for £3 10s; or, alternatively, if the Corporation undertook the cost of installation, then to maintain 44 double-burner lamps of 100 c.p. each for £2 15s., and 208 single-burner lamps of 50 c.p. each for £1 15s. per annum.

SEVENOAKS.—The Urban Council have received a report from Messrs. Mordey & Dawbarn, electrical engineers, advising them that a scheme of electric lighting for that town might be expected to be self-supporting in the third year, and to show a progressive profit up to £1,300 by the tenth year. The Council are disposed towards carrying out an electric lighting scheme.

SHEFFIELD.—The Corporation Electricity Department's profits of £2,555 in 1907, of £4,796 in 1908, and of £2,422, have been converted into a deficit of £2,035 for the past year.

SWANSEA.—The Corporation Electricity works are proving an excellent investment for the Borough. The report for last year (the ninth) shows the revenue at £23,049, of which £13,051 is from private consumers—an increase of 9%, £1,995 for public lamps, an increase of 4%, £5,240 for power, an increase of 1%, and £2,762 for tramways, an increase of 9%. The total costs are £12,283, a decrease of 7%, the gross profit £12,283, an increase of 12%, and the net profit on the year's working £2,722, an increase of 55%. There are at present 1,678 consumers on the books.

TONBRIDGE.—The gross profit for the year on the municipal electricity undertaking amounts to £1,701, or £6 8s.% on the capital expenditure. The sinking fund contributions, however, wipes this out, and leaves a deficit of £5,020, to be met out of rates.

WALSALL.—At the suggestion of the Borough Electrical Engineer, application is to be made to the Local Government Board for powers to borrow £23,225 for extensions of the generating station, plant and mains.

WEDNESBURY.—The Borough are about to extend the electricity mains in the King's Hill district at a cost of £327. Owing

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to the number of consumers applying it is probable that further extensions will soon be required. The Borough still have borrowing powers amounting to over £2,000 for this class of work.

WOLVERHAMPTON.—The Borough Electricity Committee have recommended the following report of the Engineer: That a new water softening apparatus be installed at an estimated cost of £400; that the economisers in the old boilerhouse be renewed, at an estimated cost of £600; that a pump house, lavatory, and storage tank be provided, at an estimated cost of £450; that the committee be authorised to invite tenders for the foregoing works, and to accept such tenders as they may think advisable; and that the expenditure to be incurred in respect of the foregoing recommendations be met out of the reserve fund. It is stated that when these improvements and alterations are carried out it is estimated that there will be a total saving in fuel, labour, and repairs of not less than £400 per annum.

YORK.—A Local Government Board inquiry has been held into an application to borrow £2,475 for purposes of the electrical undertaking. Of this £1,100 was required for services, £800 for motors and £575 for meters. The inspector in announcing that the loan for meters would only be granted for five years, depreciated meters being paid for out of loans.

LIGHTING AND GENERAL—Overseas.

BUENOS AIRES.—It is reported that the "Compañia Alemana Transatlántica de Electricidad," the head office of which is at Berlin, has obtained a concession for utilising the waters of the River Mendoza to generate electricity, and is now constructing the necessary works.

CARTAGENA (Spain).—A new company, entitled the Popular Cartagena, is in process of formation with the object of erecting a central electric generating station to supply electric energy for lighting and industrial purposes. The company will have a capital of 500,000 pesetas (£18,500) and the works will be equipped so as to supply a continuous current of 600 h.p.

LAHORE.—A local correspondent reports that the Municipal Committee discussed a scheme prepared by an English expert for the extension of the electricity supply. After a long debate it was resolved by ten votes to nine to reject the scheme of the electrical expert and refer the whole matter back to the sub-committee with instructions to produce a modified scheme. The proposal of the expert was to take up the existing supplies and extend them to cover Anarkali and the civil station which would provide an immediate income. The scheme could then be extended to the city as the demand arose.

PRINCE RUPERT, BRITISH COLUMBIA.—A Citizens' Committee employed Mr. Milne to draw up a scheme for the electric lighting of the town and prepare specifications. The responsibility has now been taken over by the City, and the work is to be proceeded with at once.

SIMLA.—The municipal electric supply will be ready towards the end of next year. The system will be three-phase A.C., at 220 volts, the conductors being overhead insulated wires.

URUGUAY.—The Government have granted to the Union Telephone Company, domiciled in Mercedes and Fray Bentos, a concession to construct a number of telephone lines over considerable distances between various points in Uruguay.

TRACTION—Home.

BELFAST.—The Tramway and Electricity Committee have recommended that the scheme for the extension of the tramway to M'Art's Fort by way of Crumlin-road and the Horse Shoe shall be adopted and carried through at once. The matter will come before a special meeting of the Town Council without delay.

HARTLEPOOL.—The Tramway Company are urging the Corporation either to purchase the Foggy Forge and Park sections for £22,000, to make an offer for them, or to go to arbitration. The latter course is likely to be pursued. Meanwhile the Council are contemplating the purchase of the Hartlepool section to the limit of their boundary.

ILKESTON.—An offer has been made by a private person to purchase the municipal tramways. The matter has been taken into consideration by the Town Council, but with what result is not yet known.

MANCHESTER.—The annual returns just published show that the municipal tramways had a revenue from passenger traffic of £777,219 (an increase of over £3,100), £2,263 net revenue from parcels (increase of nearly £500), and of £8,546 from other sources (decrease of over £250). The working expenses were £511,070 (increase of over £3,000). The gross profit was £282,389. Of the net profits, £70,020 was placed to reserve, renewals and depreciation account, £4,047 interest on amount spent on street improvements, and £75,000 was paid in aid of rates (increase of £5,000).

SOUTHAMPTON.—The returns of the Corporation Tramways for the year ending March 31 just issued shows the revenue from traffic to be £55,886 and from other sources £1,361. Current cost £11,044, traffic expenses £14,531, general expenses £4,634, and repairs and maintenance £7,968. The gross balance was £19,069. After allowing for interest and sinking fund, £814 was paid in respect of purchase of land, £2,000 in aid of rates, and £4,694 placed to depreciation and renewals account.

WIGAN.—The Electric Light Committee have reduced the price of current to the tramway department from 1·5-16d. to 1·3-16d. This will mean a saving of at least £1,200 a year to the tramways.

TRACTION—Overseas.

BERNE.—The Swiss Federal Government have granted the following concessions: (1) to Messrs. Isler of Goldau, Cathrein of Brigue, and Roemer of Paris, for the construction and working of a narrow gauge electric railway from Brigue via Riederalp and Eggishorn to the Aletsch Glacier; the cost of the work is estimated at 3,850,000 francs (£154,000), and three years are allowed for the completion of the line; (2) to Messrs. Baumgartner of St. Gall, Beusch of Grabs, Bohl of Stein, Hardegger of Gams, Kuhn of Buchs, and Looser of Alt-St. Johann, for the construction and working of a narrow gauge electric railway from Buchs to Nesslau; the cost of the work is estimated at 5,100,000 francs (£204,000), and thirty months are allowed for its completion; (3) to Messrs. Comte and Froidevaux, of Delémont, for the construction and working of a railway from Delémont to Mervelier; the cost of the work is assessed at 1,200,000 francs (£48,000), and two years are allowed for its completion; (4) to Mr. André Zwissig, of Seelisberg, for the construction and working of a funicular railway from Treib to Seelisberg; the cost of the line is estimated at 450,000 francs (£18,000), and it must be built within 18 months.

CALCUTTA.—The Government of Eastern Bengal and Assam have forwarded a scheme for an electric railway to Shillong and suggested the carrying out of a preliminary survey. It is extremely doubtful if this will be undertaken at once and it is quite probable that the local Government will be asked to ascertain if sufficient water power exists for generating electricity for the purpose.

OPCINA, AUSTRIA.—A concession has been granted to the "Aktiengesellschaft Triester Kleinbahnen," of Trieste, for the construction of an electric light railway from Opcina to Sesana.

ELECTRICAL PROSPECTS IN BOLIVIA.

A report from the Belgian Legation at La Paz on the condition of the electrical industry in Bolivia draws attention to the circumstance that, owing to the high price of coal and other fuel in that country, there is every prospect that greater use will be made in the future of the abundant waterfalls and rivers for electrical purposes. Hydro-electric plant, continues the report, will therefore be in increasing demand in Bolivia, especially high-tension generators with high-pressure hydraulic motors.

COMPANIES' MEETINGS AND REPORTS.

ELECTRIC CONSTRUCTION COMPANY.

The net profit for the year ended May 31st, after payment of debenture interest, and crediting £5,000 to depreciation account, is £7,123, making, with £3,688 brought forward, £10,811. The directors recommend a dividend on the cumulative preference shares, absorbing £4,394, leaving £6,416 to be carried forward. The reduction in gross profit is due to the diminution in the volume of business, but the directors hope that the recent improvement in trade may lead to an increased demand for electrical machinery during the present year.

CHILIAN ELECTRIC TRAMWAY AND LIGHT COMPANY.

At the 12th ordinary general meeting, held at the offices, London Wall Buildings, Mr. Ludwig Breitmeyer, who presided, moved the adoption of the report. He said that the company's operations in Santiago during the year showed a substantial improvement as compared with those of 1908. The tramways had carried 7,000,000 more passengers, and the receipts had improved by £54,000. The lighting and power department showed an increased profit of £34,000. They were enabled to place £32,000 to reserve and to declare a dividend of 5 per cent. on the preference stock. This very satisfactory result was due to economy and efficiency of management, to an improved rate of exchange, to the higher tariff fares maintained in accordance with their rights under the concession, and to

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the continuous expansion of the tramway traffic and the light business. The company's relations with the municipality were most harmonious. The report was adopted.

ELECTRIC AND GENERAL INVESTMENT.

Mr. J. B. Braithwaite, in moving the adoption of the report, said he thought the shareholders would be pretty well satisfied with the results of the year. Last year they showed an improvement of £4,000 on the previous 12 months, which was £13,086, and this year they showed a further advance of close upon £1,500. They were distributing 6 per cent. on the shares, and, as trustee for the reserve fund, he was distributing a further 2½% from that fund, so that the shareholders this year obtained 8½% on their investment. The balance-sheet exhibited a distinct improvement since last year. They had been able steadily to build up the contingent fund to counterbalance the depreciation in the British Electric Traction stocks which they held. This company was highly interested in the British Electric Company stocks, and they showed depreciation which, he hoped, would soon be recovered. He mentioned several events as indicating a hopeful outlook. Last year he expressed the hope that the business of the company would be increased, and that had been realised; and there were at present indications in various directions of better times. The report was adopted.

UNITED RIVER PLATE TELEPHONE.

The report for the year ended March 31 last states that the gross receipts in sterling for the year in the River Plate were £336,422 4s. 3d., against £287,064 11s. 8d. for last year. Deducting expenses in Argentina and London, debenture interest, dividend on preference shares, and interim dividend on ordinary shares, and adding interest on investments, transfer fees, etc., there remains a profit of £95,557 18s. 3d., to which must be added £5,138 1s. 5d. brought forward from the previous year, making an available balance of £100,695 19s. 8d. After appropriating £30,000 for replacement fund, £30,000 for reserve fund, and £2,000 for Staff Provident Fund, the directors recommend that a final dividend of 5% be paid on the ordinary share capital of the company, making the interim dividend paid on December 31 last a return of 8% for the year, free of Income Tax, and that the balance of £4,633 9s. 8d. be carried forward. The steady and satisfactory increase of the business necessitates the introduction of further capital, and it is therefore proposed forthwith to make a fresh issue of 40,000 ordinary shares to the ordinary shareholders at par. For this purpose an increase in the nominal capital of the company will be required, and a resolution to this effect will be submitted at the meeting.

MADRAS ELECTRIC SUPPLY CORPORATION.

In their fourth annual report, for the year ended December 31, 1909, the Board state that the construction contract is now practically completed, although the plant has not yet been officially taken over from the contractors. The tramway supply commenced on January 12 last. As the contractors' workmen have been engaged in the generating station during the whole of the year 1909, erecting machinery and testing the same under steam, it was impossible to run the station under proper normal conditions and difficult to estimate the actual costs. The board have in consequence placed the whole of the working costs up to December 31, 1909, less receipts, to a suspense account, which will be written off by instalments out of future profits. On April 3, 1909, when the supply from the permanent plant commenced, there were the equivalent of 5,200 8-c.p. lamps connected to the mains, and at December 31 the equivalent number was 29,057, with 4,562 more waiting connection. At the date of the last report (June 16) this number was further increased to 40,981, with 5,105 waiting connection. In addition, the tramway demand is equivalent to 16,666 lamps. New consumers are being added every week, and the directors look forward with confidence to a considerable increase during the current year. The licences applied for by the company to enable a supply of electricity to be made to the Port Trust at Madras and to Fort St. George have been granted, and the supply has commenced. Applications are frequently being received for extensions of mains for supply of current to new consumers. In order to meet the outlays required for such extensions, to pay off the loan from the bankers, and to provide an adequate working capital for the company's business, the directors propose to make an issue of £100,000 of 6% first mortgage debentures, which will shortly be offered to the shareholders.

GENERAL ELECTRIC COMPANY, LIMITED.

The report of the directors to be submitted at the ordinary general meeting, to be held at 67, Queen Victoria-street, on Tuesday, July 19th, states that the net trading profits and income from investments, etc., amount to £95,461 12s. 6d.; after deducting depreciation and debenture interest, amounting to £27,057 8s. 10d., there remains a balance of £68,404 3s. 8d. Out of this the dividend on the preference shares at the rate of 5% for the year ended March 31st, 1910, has been paid, absorbing £12,500, leaving an available balance of £55,904 3s. 8d. This the directors recommend should be appropriated as follows:—Provision for managing directors' and employees' bonus, £5,590 8s. 4d.; provision for dividend on ordinary shares at the rate of 5% for the year ended March 31st, 1910, £19,395; to reserve account, £22,000; balance to be carried forward, £8,918 15s. 4d.; total £55,984 3s. 8d. The reserve account amounts to £136,488 0s. 10d., the proposed appropriation of profit of the year, ended March 31st, 1910, amounts to £22,000, giving a total reserve account of £158,488 0s. 10d. The result of the trading for the year to March 31st, 1910, has been satisfactory. The factories at Witton, Salford, Birmingham, and London have been well employed during the year. The switch-gear, arc lamp and small motor departments have been removed from Salford to Witton. Peel Works, Salford, are now entirely devoted to the manufacture of telephone and telegraph apparatus. The directors have thought it desirable to carry on these departments as a subsidiary company, and part of the assets of these works now appears under investments. As the transfer has been made during the latter half of the year, the profit and loss account has not thereby been influenced. Further ordinary shares to the number of 1,395 have been allotted during the period covered by the accounts to the directors and staff at par. Mr. M. Railing retires by rotation from the position of director, and, being eligible, offers himself for re-election.

PARA TRAMWAYS.

The directors of the Para Electric Railways and Lighting Company, Ltd., announce that the first dividend on the 77,145 Ordinary shares of £5 each will be at the rate of 8% per annum for the half-year ending May 31 last, payable on September 1. This company was formed in the year 1905 to purchase the mule tramways and electric lighting business in Para under a concession for a period of 99 years, with the intention of converting the tramways to electric traction and extending the lighting business. The reconstruction of the tramways and certain improvements to the lighting system were completed in 1908; in 1909 the company purchased a large majority of shares in the only other electric supply company in Para, and arrangements are being made to work the two properties together more economically and efficiently than they could be worked separately. The following figures show the results for the last two complete financial years:—

Comparative Statement of Earnings and Expenses.

Year ending November 30.	1908. £	1909. £
Gross receipts	205,311	225,917
Operating expenses	152,637	120,310
Net earnings	52,674	105,607
Fixed charges and London Expenses, etc.	36,460	45,017
Surplus	16,214	60,590

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The first half of the current financial year shows cabled net earnings of £62,360, representing an increase over a similar period in 1909 of £18,253. In past years the second half of the financial year has always shown better returns than the first half, and it is anticipated that the increase will be at least maintained, showing total net earnings for 1910 of £130,000. Last year the Debenture interest, London expenses, etc., amounted to £45,017, which if deducted from the estimated earnings for 1910 would leave a surplus of £84,996. In 1909 the equivalent surplus amounted to £60,590, to which had to be added the amount of £9,863, brought forward from the previous year, making a total of £70,453. Out of this sum the dividend for the year on the Preference shares was paid, amounting to £17,499, and £15,000 was added to reserve for depreciation and renewals, £10,000 to reserve for contingencies, and the arrears of cumulative dividends on the Preference shares for the years 1906 and 1907, amounting to £27,000, were paid. The directors appear to have acted conservatively in declaring an interim dividend at 8% per annum, and it would be fair to assume that there are prospects of a larger distribution for the year 1911. Para is the commercial centre of the Amazon Valley, and has a population of about 150,000, which of recent years has expanded greatly, as a result of the general prosperity of Brazil.

LIFTS.

Owing to the rapid increase in their business as lift manufacturers, Messrs. Smith, Major and Stevens, Ltd., have for some time past found their Battersea premises very inadequate for their growing needs, and have been compelled to provide new works, which are now in course of erection at Northampton. A spacious plot of land has been secured affording ample opportunity for further expansion, and it is intended that the new premises shall embody not only the most modern manufacturing improvements, but shall provide also for the greater comfort and health of the workmen and staff. It is hoped that all will be ready for occupation in the autumn. A portion of the staff and a considerable number of workmen will be retained in London in the interests of the extensive connection possessed by the company in the Metropolitan district, where they and their predecessors have been established for 140 years.

REEDHAM ORPHANAGE.—At the annual meeting of the Reedham Orphanage Mr. Cosmo O. Bonsor announced that the Committee of management had taken advantage of a generous offer made to them to purchase electrical plant at a low price, and had now decided to instal electric light and power. By doing so they anticipated a better light, an economy in decorative expenditure, and a great saving in gas and coal.

PATENTS.

Electric Energy Meters.

13080.—1909. EVERSHED & VIGNOLES, LTD., Chiswick, W. The fixed coils are wound around metal formers which form terminals for them without connecting wires. The disposition and winding of the armature with respect to the field coils give an astatic arrangement. The armature driving fields are provided by coils whose magnetic fields pass through the armature disc in opposite directions, the armature being wound so that the direction of current in one half is opposite that in the other half.

Incandescent Electric Lamps.

13228.—1909. C. O. BASTIAN, Brondesbury, N.W. The filament is formed in two or more separate sections arranged tandemwise in the lamp tube. Means are interposed between the ends of the adjacent sections to main them in tension. These means consist of a spring which makes contact with the wall of the tube lamp without being attached to it.

Electric Signalling Apparatus.

13237.—1909. W. H. JOHNS, Charlton, Kent. This is an improvement in signals of the resonance type, wherein signs, etc., are exposed by the vibration of elastic bodies, and wherein tongues are employed, each furnished with a laterally projecting shield. A scale plate is provided formed with fingers on which the inscription is portrayed, and between which the tongues or the shutters vibrate. The inscription is exposed during both the forward and backward movement of the shield.

Incandescent Electric Lamps of the "Nernst" Type.

13391.—1909. A. CLARKE. Cheapside, E.C. A non-conducting base plate is provided for the lamp. The back of the plate is provided with the usual bracket for attachment to the lantern tray. A horizontal holder is situated also at the back of the base plate and placed in electrical contact with one of the terminals. This horizontal plate has several equidistant circular holes and notches lead from it at diametrically opposite points. The resistances have metal necks which fit loosely round the holes of the horizontal plate. Studs on the neck fit into the slots which enables the resistance to be suspended in a vertical position and in electrical contact with one end of the filament of the resistance.

Electric Interrupters for Ignition Purposes.

13573.—1909. J. L. MILTON, Chicago, U.S.A. This interrupter first makes contact with an element whereby a generator and transformer circuit is closed; it then breaks contact with that element whereby the transformer circuit is broken and a condenser is charged. Contact is next made with a further element whereby the transformer circuit is closed and the discharge of the condenser acts through the transformer to generate the required current.

Coverings for Cables, Etc.

13576.—1909. T. H. M. HARVEY & J. W. BASS, Bromley. A number of strands are wound helically round the conductor. At the same time one or more strands are wound in a longitudinal manner over and under the first named strands to prevent them from unravelling.

Telephones.

13771.—1909. C. ADAMS-RANDALL, New York, U.S.A. A variable granular resistance conductor is provided which has a large superficial area as compared with an electrode in contact with it. The resistance conductor is arranged to have a low resistance so as to permit of the use of a current of low voltage and at the same time a large conducting capacity to permit of the use of a current of high voltage.

Transformation of Electrical Energy into Heat Energy.

13827.—1909. C. O. BASTIAN, Brondesbury, N.W. In this device for transforming electrical energy into heat energy, the resistance enclosure between the terminals is made of a number of small tubes or sections of quartz, kaolin, or steatite.

Apparatus for Opening and Closing Electric Switches.

14052.—1909. J. G. MEHNE, Wurtemburg. This switch, which is designed to turn off gas lights at definite times, is actuated by the sudden release of a lever. The pin on the 24-hour wheel serves first to lift a catch which releases the operating lever, and afterwards to press back the lever into re-engagement with the catch.

Electrolytic Apparatus.

14660.—1909. W. THUM, Grasselli, U.S.A. This electrolytic apparatus, which is designed for refining precious metals, comprises a tank with an inclined floor, an anode cell supported in the tank above the higher part of the floor, and provided with a perforated bottom and side perforations near the surface of the electrolytic fluid in the tank. Anode and cathode terminals are connected with the anode material and the bottom of the tank.

Means of Producing Synchronism between the Rotation of a Controlling Machine and the Rotation of Electrically Driven Machines.

15981.—1909. E. L. A. LERTOURNE, Rouen. The invention consists in directing the electrical current collected by the successive contacts of a rotary distributor of which the rotating part is driven by the controlling machine, into the successive contacts of a rotary receiver of which the rotating part is driven by the controlled machine. The contacts of the receiver each in turn send the current to the motor of the dependent machine and compel it to adjust its speed to that of the rotating part of the receiver, that is, to progress by successive positions from one contact to the next contact.

Alternating Current Electric Induction Motors.

16811.—1909. SIEMENS BROS. DYNAMO WORKS, LTD., Westminster, S.W. The object is to secure good contacts which, in addition to cheapening the cost of the motor, reduce the risk of bad contacts to a minimum even when comparatively unskilled labour is employed. The whole winding of the squirrel cage is cast in one piece and in one operation in position on the core of the rotor. The winding consists of any metal having a suitable melting temperature and electrical resistance. All contacts are done away with and any desired shape of rotor slot may be used.

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Insulating Device for Electric Lamp Holders.

17101.—1909. H. HIRST & H. J. COATES, Salford. A split hollow sleeve of insulating material, provided with an internal flange is made to receive the lamp-holder, which is secured in position by a nut with an insulating tubular extension. The lamp cap, shape and guard are also provided with protective insulation.

Dynamo Electric Generating Systems.

17189.—1909. A. H. MIDGELEY & C. A. VANDERVELL, London, W. In this system, which includes secondary batteries, a driving device is disposed between the source of power and the shaft, and is adapted, when the speed has dropped below a critical point, to allow the dynamo to overrun the prime mover as a motor driven from the secondary batteries and thus prevent any excessive discharge of current through the dynamo armature during the non-generating period without the use of electrical cut out devices.

Electrical Detectors or Contact Makers.

19434.—1909. E. C. IRVING, Westminster, S.W. In this detecting apparatus for railway switch points, combined with separate slides—one connected to each switch tongue—is a spring contact carrying bar which projects across each slide. Contacts are carried by the bars, and adjustable devices are carried by insulated tongues from the slides. These adjustable devices actuate the spring contact carrying bars. Circuits are adapted to be alternately made and broken by the movements of the adjustable devices with the slides and switch points.

Magneto Ignition Devices for Internal Combustion Engines.

20013.—1909. F. BRUCKERT, Ferriere la Grande. This improved regulating device comprises a shaft which carries the interrupter cams as well as a pin fixed to the shaft and slidably guided within two helicoidal grooves of a sleeve on the shaft. The sleeve is solid with a pinion and receives its movement by the governor shaft of the engine. A key way in the shaft engages with the key of a level wheel which slides in the axial direction on the shaft and transmits its movement to the armature and shutter of the magneto. The movement of the interrupter cams and that of the magneto is constantly synchronous. The desired lead or lag is given to the ignition by the operation of a forked lever acting on the shaft.

Dynamo Electric Machine.

20584.—1909. BRITISH THOMSON-HOUSTON COMPANY, LTD., London, E.C. This machine comprises an armature which carries a number of sets of conductors axially displaced from each other and having their ends connected to sets of collector rings with which brushes engage. A field magnet forms a number of axially displaced unipolar fields within which the sets of armature conductors revolve. Separate field coils magnetise the unipolar fields whereby the relative induced voltages in the sets of armature conductors may be varied by varying the currents in the separate field coils.

Signal Systems for Railways.

21101.—1909. BRITISH THOMSON-HOUSTON COMPANY, LTD., London, E.C. This is an improvement in block signal systems for electric roads in which both rails are conductively continuous for all currents. An extra relay is placed near to the source at the entrance or exit of the block on the side on which a car approaches a source. This relay controls the signal for the block jointly with the two relays on the other side of the source. With this arrangement it is the extra relay which determines the point at which the signal goes to danger and since this relay may be placed much nearer to the source than the other relays the point at which it operates is fixed in correspondingly narrow limits.

Method of Working Arc Lamps in Series with Incandescent Lamps.

22302.—1909. A. HEIMANN & W. SCHAFFER, Berlin. A variator, *i.e.*, an iron wire resistance which is enclosed in an atmosphere of hydrogen is interpolated in the circuit comprising the incandescent lamps and arc lamps in series. The variator changes in resistance when the current fluctuates so that the current is kept constantly within those limits and the incandescent lamps burn satisfactorily and are not disturbed by the fluctuations which occur when the resistance of the arcs of the arc lamps varies.

Electrical Table Fittings.

23071.—1909. C. VAUGHAN, Oxford-street, W. The base plate has a protected spring actuated cover provided with slots through which the pins for making connection with metallic strips can project. The lamp is placed on a block, thin pins touch the metal and a circuit is completed for lighting the lamp.

Burglar Alarm.

23506.—1909. A. S. NEWMAN, Highgate. A wire cord is stretched across a window or door, and this when deflected causes a sliding rod to operate a lever which in turn closes an electric circuit so as to give an alarm. The alarm continues until the lever is replaced.

Electric Circuit Closing Devices.

23719.—1909. ACME AUTOMATIC STREET INDICATING COMPANY, Cleveland, U.S.A. In an electrical contact for use with moving vehicles a pair of opposed brushes are employed, each having metallic bristles. The adjacent ends of the opposed brushes are spaced apart to receive the contact device carried by the vehicle.

Electric Furnaces.

26251.—1909. J. HARDEN, London, E.C. The furnace is provided with two or more electrodes which depend from the roof and are situated within a short distance of the charge. Two or more terminal plates composed of metal and faced with second class conducting material are let into the furnace walls. These plates operate independently of the electrodes and have their metal portions cooled by the circulation of a cooling medium.

Means for Actuating Electro Mechanical Fog Signals.

26687.—1909. G. LOWTHIAN, Westminster. A pair of semaphores on the locomotive represents the position of each main signal. These pair of signals are operated electrically, the first one by a local current on the locomotive which causes one of the signals to fall to the danger position as the locomotive reaches a line bar in front of such signal, the second signal of the pair requires a current from the signal box communicated through the line bar to raise the second semaphore to the line clear position, whilst the first semaphore is brought up again by the same action out of sight.

Driving Axles of Electrically Propelled Vehicles.

28475.—1909. D. BALACHOWSKY & P. CAIRE, Newlly-sur-Seine. This is an improvement in driving axles of the kind in which the wheels are fixed to the driving axles that are driven without the interposition of any mechanical power transmitting devices by an electric motor. The invention provides means for speedily dismantling the motor without having to remove one or the other of the wheels of the axle. All the insulating parts and all the elements of the motor are arranged in such manner that they shall not be affected by shock and vibration.

Electric Conductors.

1301.—1910. SIEMENS BROS. & COMPANY, & W. DIESELHORST, Westminster. This is an improvement in conductors constructed of two parts, one of copper, for giving conductivity, and the other of iron for giving tensile strength. A sheathing is provided consisting of two or more turns sweated together solidly with solder and so arranged that each joint comes opposite and is protected by an unseamed portion. The use of this double turn ensures complete protection of the conductor, and prevents access of moisture.

Railway Electric Automatic Tablet.

3902.—1910. J. SAYERS & G. SALT, Derby. This tablet is so arranged in combination with a similar instrument at the far end of the block section, that one, but not more than one tablet can be withdrawn without the manual co-operation of the far station. The tablets can be taken by the guard or driver of the train so that permanent operators are dispensed with.

Regulating the Position of Brushes on Commutators of Dynamo Electric Machines.

3914.—1910. SIEMENS BROS. DYNAMO WORKS, Westminster. A lever system is provided which operates first with one leverage and later with another leverage in such a manner that the brushes are firstly moved forward then allowed to move backwards more or less, and then moved forwards again to the final position.

Electrolytic Production of Alkaline Metals.

6063.—1910. SOCIÉTÉ D'ELECTRO CHIMIE, Paris. The apparatus for carrying out the electrolytic production of sodium or other alkaline metals consists in an anode formed by two electrically co-axial plates placed one outside and the other inside a cathode disposed in the intervening space between the two cylinders. A combined arm and conductor placed at the lower extremity of the cylinders connects the two plates forming the anode.

Electric Condensers.

9832.—1910. E. & W. H. WILSON, Blackheath, S.E. This condenser, which is suitable for high frequency work, comprises pairs of electrodes separated by insulation. Each electrode is sub-divided into parts conductively connected in such manner as will minimise the circulation of eddy currents.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year.						Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	June 29	1,370	1,338	+ 32	+ 135	27½	27½	May 31	71,930	17,517,304	1 566,119	·98	11·02	4,940,	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+2,071	—	·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	July 3	1,216	1,232	— 16	+ 212	13 68	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	July 2	6,785	6,642	+ 143	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	July 2	5,049	5,064	— 15	+ 1,206	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	July 10	1,025	966	+ 59	— 445	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	July 8	6,203	5,970	+ 233	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	July 9	1,221	1,250	— 38	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	July 10	279	276	+ 3	— 40	6½	6½	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 5	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	July 9	6,026	5,608	+ 418	—	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6 822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	June 26	3,078	3,327	— 249	— 723	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	July 7	530	623	— 92	+ 1,653	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	June 24	1,834	1,423	— 411	+ 2,255	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	July 8	163	188	— 25	+ 25	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	July 8	5,680	5,699	— 19	— 106	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	July 9	1,049	1,043	+ 6	+ 334	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	July 2	18,286	17,126	+ 1,160	+ 6,478	194½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,060	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	July 9	2,738	2,595	+ 143	+ 2,404	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	July 7	131	141	— 10	— 92	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	July 6	1,339	2 123	— 784	— 533	39	39	Dec. 31	68,904	12,554,593	2,244,844	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	July 3	1,414	1,539	— 125	+ 785	6·65	2·40	June 30	79,004	11,171,515	1,106,886	—	—	—	—
London County Council	June 25	43,207	39,829	+ 3,378	+ 74,634	132½	118½	Mar. 31	1,274,660	279 166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+ 57	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	July 9	11,221	10,341	+ 880	—	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	July 10	17,628	17,099	+ 529	—	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	July 2	3,740	3,546	+ 194	— 575	60½	59½	„ 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,096	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	July 3	5,977	5,718	+ 259	+ 4 637	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	June 29	1,108	1,058	+ 50	+ 543	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	June 29	142	133	+ 9	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	July 2	986	988	— 2	— 422	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	June 30	2,510	2,268	+ 241	+ 1,173	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. h Half-year's figures.

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THE
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NOTES.

Mechanical Engineers' Conference.

The full programme of the joint Summer Meeting of the Institution of Mechanical Engineers and of the American Society of Mechanical Engineers is now out and is very good. A large number of interesting excursions, in which pleasure is judiciously blended with instruction, have been planned. At Birmingham, between July 25 and 28, eight papers on mechanical subjects will be read and discussed. In London, between July 28 and 30, five papers, all on electrical subjects, will be read, the lecture room of the Institute of Civil Engineers being lent for the purpose. The papers are: Electrification of Suburban Railways by F. W. Carter, Rugby; Cost of Electrically Propelled Suburban Railways, by H. M. Hobart; Economics of Railway Electrification, by W. B. Potter, of Schenectady, New York; Electrification of Trunk Lines, by L. R. Pomeroy, New York; Electrification of Railways, by George Westinghouse, Pittsburg. Such a series of papers ought to produce a valuable exchange of opinions.

Turbo-Electric Locomotives.

Seeing the great attention to be paid to railway electrification at this meeting, it is timely that the new type of engine constructed by the North British Locomotive Company, of Glasgow, should be available for consideration and discussion, having concluded satisfactory trips on the Caledonian and North British Railway Companies' lines. In this engine a boiler of the ordinary locomotive type is fitted with a super heater, and steam passes to an impulse turbine, running at 3,000 r.p.m., to which is coupled a D.C. variable voltage dynamo. The dynamo supplies current varying from 200 to 600 volts to four series-wound traction motors, placed over the four driving wheels, the armatures being built on the axles. The exhaust steam passes into an ejector-condenser, and with the condensation is delivered into the hot-well. The water of condensation being free from oil is returned to the boiler. The condensing water circulates through what is practically a closed circuit, from the tanks through small centrifugal pumps, on to the condenser, where it becomes heated, into the hot-well. Thence a second pump passes it on to the cooler, placed in front of the locomotive in order to secure the help of the blasts of air, which is aided by an electrically driven fan, returning to the tank, cold and ready for condensing work. The pumps are driven by auxiliary steam turbines, placed adjacent to the large turbine. As the induced draught is used for cooling purposes, a fan is placed within the cooler to provide heated air to the fire-box. The switchboard, controller for grouping the motors in series, and voltage regulator, are all placed close together on the driver's platform. It will be seen that by this system a comparatively small provision of water suffices for a very long run.

Compulsory Wireless at Sea.

Sir Edward Sassoon has obtained leave to introduce his Bill to render the installation of wireless telegraphy on passenger ships compulsory, which has been read a first time. In introducing the measure, Sir Edward thought that, when a big demand was created, an installation could be supplied for £200 or under. He did not think that it would be necessary in every case to provide a special cabin, and in the smaller vessels he suggested that an expert telegraphist could be replaced by the junior engineer. As against the expense, there would be the greater safety on the one hand and the appreciable reduction in premiums allowed by underwriters. It was pointed out that New Zealand already possesses the power to compel all ships leaving her ports to carry wireless installation; so does France, and in her case insists on all subsidised ships being so provided. Italy possesses the same powers, and in the United States of America a Bill giving similar powers has passed the Senate and is now before the House of Representatives. Sir Edward's Bill provides that after twelve months from its becoming law no British or foreign-owned ship carrying passengers, or 50 people, including passengers and crew, should leave any British port unless it had wireless telegraphic apparatus efficient to carry messages for 100 miles, but that provision would not apply to coastwise ships. It further provides for the free transmission of messages giving information as to the safety of ships and those on board, and other information with regard to navigation. It imposes a penalty of £1,000 on any vessel infringing this stipulation. Another clause requires the Board of Trade to frame necessary regulations.

Leicester's Electricity.

The Leicester Corporation having decided not to appeal against the judgment forbidding "trading," is turning in another direction in order to make the electricity undertaking a paying success. Mr. James Swinburne has been called in by the Gas and Electric Lighting and the Electric Tramways Committees to advise upon the proposal to amalgamate under one control the electric lighting station at Aylestone and the electric power station at Belgrave. The advocates of this amalgamation scheme contend that: (1) The whole electricity production and supply for lighting and power would be under the control of one special committee, whose duty it would be to supply electricity at the cheapest possible rate. (2) It would stop friction between committees and abolish insane and unnecessary competition. (3) Consumers and users of light and power would have free choice in taking alternating or direct current—whichever suited them best—at equal cost. (4) The present ducts, cables, and machinery could be more economically used for the present purposes and future extensions of supply. (5) One central office—part of the present gas offices being available—could be extended, where all requiring electricity for light or power could apply. (6) Amalgamation would mean the retention of the present engineering and clerical staffs, with less friction and better control and economy of management.

"Competent" Under the Factory Act.

It is to be hoped that the case of the Newcastle Electric Supply Company, Ltd., will be taken to appeal. It was admittedly a test case on the part of the Home Office, and therefore is of special importance. Briefly, the points are these: Liddell, a carpenter, was employed by the company to do carpentry work at the Philadelphia distributing station. He was engaged in this work with an electrician in the chamber behind the switchboard, when by some means he came in contact with the conductors, and receiving a charge of 3,000 volts, was killed. The prosecution contended he was not a "competent" person within the meaning of the Act. The defence was that he was a competent carpenter, in full possession of his faculties, and having received instructions as regards the electrical risks, and being employed solely on carpentry work, he was, for such work, "electrically competent." The Bench held otherwise, and fined the company £10. No costs were asked

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for, as this was a test case; but on the application of the defendants, recognisances were fixed at £100 in view of an appeal. The point is one of the utmost importance to all responsible for the management of power stations, for it is necessary on occasions to employ men for special work who are not electricians. Is it sufficient that such persons should be specially warned of risks, and only allowed to take up a job under adequate supervision, or must they have received a certain amount of electrical training, and if so, how much? The case was heard by the Houghton-le-Spring Bench. It is far too big a question to be left to such a tribunal.

Inventions.

Referring to new inventions reminds us that news comes to hand that Chief Mate Richardson, of the cable ship *Restorer*, has invented an appliance for locating lost cable ends. Details are not yet available, pending arrangements over patents, but it is understood that a highly magnetised instrument is drawn over the bottom of the ocean, and that the moment it passes over the cable it has the effect of lighting a small electric lamp in the testing room of the cable ship.

Cinema House.

Cinema House, the latest thing in cinematograph theatres, opened by the Duchess of Portland for the London Cinematograph Company (1909) Ltd., in Oxford-street, is a sufficiently arresting instance of how wonderfully electricity has progressed in certain minor paths. Apart from the very handsome appearance of the house, with its seating accommodation for 500 spectators, the lavish use of electricity for lighting, ventilating and so on, the development and control of the pictures is of the highest order. Although the preliminary ceremonies were quite brief, yet, after a few speeches, the first picture shown was a film depicting the Duchess and visitors coming into the hall. The taking of the photographs, development of the films and preparation were all completed within one hour and a half.

Metalite, Ltd.

Information is to hand that the prospectus of Metalite, Ltd., will appear on Monday next. The capital is £500,000, in £1 shares, of which 380,000 will be offered for subscription. The company has been formed to acquire as going concerns the "British Metalite" lamp and metallic filament manufacturing business in the United Kingdom of the Bryant Trading Syndicate, Ltd., and the business, patents, processes, and good will of International Filaments, Ltd. As regards price and efficiency, the "British Metalite" lamps are superior to any of the foreign productions sold in this country, and orders are received for such vast quantities that the present factory accommodation is totally inadequate to cope with the demand. Contracts at a substantial profit and exceeding fifteen million (15,000,000) filaments per annum for the next five years are already in hand and in course of execution, in addition to large trade orders from, amongst others, over 50 Corporations, the War and Admiralty Departments, Home Office, Crown Agents for the Colonies, several of the principal home railways, tramway corporations, hotels, and National Telephone Company. A site has been inspected and plans approved for the erection of a factory nearly 12 times as large as the one at present occupied, and on completion of the proposed development contracts for many additional millions will be available for acceptance. The company appears under strong auspices, and as a large number of shares have been applied for before the issue of the prospectus, there is every reason to believe that the capital will be considerably oversubscribed.

THE ELECTRICAL COMMITTEE.

The Committee for the Protection of Electrical Interests met on July 6, at Faraday House, and discussed the procedure to be followed. It was decided that the President, Vice-President, Hon. Treasurer and Hon. Secretary should form a Committee of Management entrusted with power to call meetings when necessary, and generally to prepare the business for the Committee. Those interested in the electrical industry are requested to communicate with the Hon. Secretary, Mr. R. Borlase Matthews, Bank Buildings, Kingsway, W.C., with reference to any question that they may wish to bring before the Committee. As mentioned in the previous report the President has been requested to make endeavours to form a Parliamentary party in the House of Commons. He will welcome any suggestions as to the composition of that party which may be addressed to the Hon. Secretary.

ELECTROLYTIC DISINFECTING FLUID.

Dr. F. W. Alexander, Medical Officer of Health for the Metropolitan Borough of Poplar, in his annual report just issued, gives details of the municipal manufacture of electrolytic disinfecting fluid. He states that owing to the demand for the fluid, the dismantling, overhauling and cleansing of the apparatus had to be carried out on Sunday, the men working overtime; this, together with the fact that to meet the public demand overtime had to be resorted to and the supply to the Works Department curtailed, induced the Committee to consider the advisability of recommending the Council to purchase an additional plant. There was no need for new saturators.

In view of the difficulty of meeting the demand for the fluid, and of the use of the disinfectant in connection with the Public Swimming Baths, the Public Health and Housing Committee were of opinion the duplication of the plant was necessary, and recommended the Council that additional plant, as specified, for manufacture of disinfecting fluid by electrolysis, be obtained and fitted up at an estimated cost of £430.

The new plant has been installed whilst this report is being written (February, 1910) and is as follows:—

Four Electrolysers* good for an output of 25 gallons of fluid at a strength of †4 grammes of Chlorine per litre and suited for a 240 volt circuit.
One Electric Motor (for a 240 volt circuit), arranged to hang vertically and driving two stirring machines.
Two Stirring Machines running on ball bearings and fitted with suitable grooved pulleys.
Two Ebonite Stirring Rods fitted to machines.
A Constant Head Flow Regulating Tank, suitably coated with preservative paint.
A Flow Regulating Cock with vernier.
A Mixing Tank of latest pattern.
A Switchboard mounted with 2 D.P. Switch good for 25 amps. in cast-iron case.
4 S.P. Porcelain Tubular fuses;
An Ampere meter;
A Voltmeter;
with provisions for the Council's meters.
A Series Rheostat.

By including (as mentioned above) a stirring motor of vertical pattern, two stirring machines and two stirrers—one working on the old plant and one on the new—the production is made practically automatic and enables both plants to be worked simultaneously, and necessitates no addition to the staff.

The cost of the entire plant as specified was £430; the Council provided rough labour that was required in addition.

The saturated solutions are now lifted into the large top supply tank by means of a pump instead of being carried up by hand in pails, a matter occupying ten minutes instead of an hour and a half.

The two plants can deliver in eight hours 400 gallons of electrolytic fluid at a strength of 4·5 to 6·1 grammes of Chlorine per litre. The quantity mentioned above can of course be increased or diminished by opening or shutting the valves, the strength varying in proportion to the number of amperes allowed by the rheostat to pass through the electrodes.

* The tanks were made of earthenware (which if well glazed will never wear out). Earthenware is one of the best insulating materials. Tanks made of slate contain iron (it seems impossible to obtain slate free from iron) and were being constantly destroyed by the action of the electric current and had to be often replaced.

† With a current of 25 amperes there is obtained over 6 grammes of chlorine per litre. This efficiency is no doubt due to the new shape of the electrodes and to the earthenware tanks.

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EXPERIMENTAL ELECTRICAL CIRCUITS FOR LABORATORIES.*

By W. P. Steinthal, M.Sc., I.E.E.

The question of the equipment of laboratories for experimental work as regards the distribution of electric current first came to my notice some 10 years ago when Professor Arthur Schuster commissioned me to prepare a scheme for the new Physical Laboratories about to be built for the Manchester University. At that time there was no physical laboratory in this country in which any elaborate system of distribution had been adopted. It was therefore considered advisable to see what was being done on the Continent, and for that purpose the then recently completed Electrotechnical Institute in Darmstadt was selected for a visit of inspection. From the observations made at this Institution, together with valuable advice and suggestions from Professor Schuster, a scheme of electric distribution was evolved for the Manchester Laboratories, and the installations that have been erected in recent years, and of which I propose to give short descriptions later are the outcome of the experience gained at Manchester.

In arranging a distribution scheme for laboratory work we have to consider the special requirement of a laboratory, in which the chief objects to be attained are :—

1. To supply a source of current that will give a steady pressure.
2. To provide a centre of distribution such that various voltages can be made available on different circuits simultaneously.
3. To arrange a network of circuits that shall be as inexpensive as possible in first cost, that will lend itself easily to alterations or additions, and that will maintain a high insulation resistance.

Source of Current.

For laboratory purposes a battery of accumulators is essential as furnishing the only means of providing absolutely steady currents. It may be said that any standard make of secondary battery will suffice, provided that the plate selected will allow of a high rate of discharge if required. The question then arises as to the best arrangement for charging the cells. Leaving out of account the cases where the laboratory has its own generating plant, we will consider the question of a supply from public mains. In the majority of cases we may take the voltage available to be between the limits of 200 and 250. As a general rule, the battery will consist of from 30 to 55 cells, which means that the maximum voltage required will be 140. There are then two alternatives, either to charge direct from the mains through a suitable rheostat or to instal a motor-generator. As you cannot expect to obtain a greater combined efficiency than 70% from a motor-generator of comparatively small size, it will be noted that the losses will be the same in both cases if the supply is 200 volts, and will be in favour of the motor-generator set when the supply voltage exceeds that amount. As an alternative to an ordinary motor-generator we have now available a direct-current motor converter. I am informed by the makers that for a machine of 12 kw. output converting direct current from 200 to 140 volts, an efficiency of nearly 90% can be guaranteed. We have, however, more important considerations to take into account than percentage efficiency. We have to take into account that the cells will be unevenly discharged as explained later, and that we have therefore to provide means for obtaining low voltages down to, say, 15 or 20 volts. It would then appear to be most convenient to split the generator into two and instal either a dynamo at, say, 110 volts and a small booster at 50 volts (assuming that 140 is the charging voltage for the whole battery), or two similar dynamos giving 70 volts each. In the former case the two machines would be used separately or in series and would each be driven by a motor; or, again, two converters of the type referred to above would be installed. In the latter case the two machines can be mounted on one bed-plate with the motor in the centre, all three machines driving on one shaft. The generators can be used separately, in series, or in parallel.

* Original Communication to the Institution of Electrical Engineers.

The second arrangement is on the whole the more convenient of the two, because we get the additional advantage of having a set eminently suitable for running lecture table arc lamps and also providing a heavy current by paralleling the two machines. Of course, a machine giving 110 volts is almost as useful as one giving 70 volts for arc lamp work. The choice will then depend on the requirements, and, generally speaking, the first alternative is the more convenient for a physical laboratory and the second for a chemical laboratory where heavier currents are as a rule required. Next comes the provision for alternating current. Here, again, two cases arise. Firstly, where the supply is continuous current, it will be found convenient to instal a motor-generator and possibly to arrange the dynamo with slip-rings, so as to make provision for 1-, 2-, or 3-phase current. Secondly, where the supply is alternating, it will be merely a question of providing a suitable transformer for the requirements of the laboratory. In physical laboratories a single-phase alternating current is all that is required in the majority of cases, and the demand for current is not likely to exceed 25 amperes. But the chemical laboratory will require much heavier currents for furnace work. I believe that for certain types of furnace an alternating current is found to be most suitable and the current required may be anything up to 2,000 amperes. The heaviest currents will be used at comparatively low voltages ranging from 26 to 50 volts. The question arises as to the best type of generator to instal for furnace work. I am inclined to follow the practice in America and have a single-phase machine with the armature divided into four exactly similar sections, so wound that the four sections can be coupled up in series or in parallel. In the machine that I have selected each section has an output of 350 amperes at 25 volts, so that we get from the machine either 1,400 amperes at 25 volts, 700 amperes at 50 volts, or 350 amperes at 100 volts. The voltages may be further varied within certain limits by varying the excitation of the fields. In cases where an alternating current is available a transformer can be used on similar lines. In the Massachusetts Institute of Technology a 50 kw. transformer is provided. The primary is connected to a 1,100 volt circuit. There are 16 independent secondaries, so wound that each can deliver 300 amperes at 10 volts. The terminals are arranged so that the sections can be placed in series or in parallel. At the Columbia University Laboratory a set such as I have just described is used. There they have a 50 kw. alternator driven by a direct current motor. The armature is divided into four sections, arranged so as to be connected up in series or in parallel giving voltages of 25, 50, or 100, with the full current of 2,000 amperes available at the lowest voltage.

Distribution.

Here the most important requirements is to arrange a method of delivering current at any desired voltage to any of the laboratory circuits, and to ensure that the arrangement can be easily manipulated without loss of time from a convenient centre. The voltages may vary from, say, 4 up to 110, but except for certain electrolytic experiments it is probably most convenient to arrange the source of current so as to vary the voltage in multiples of 10. This being the case, we divide the battery into groups of five cells and arrange our distribution board so that these groups of cells can be connected up in series to give the necessary voltage. We then have to design the distribution board so that the groups of cells can be discharged on to any of the circuits as required. The actual type of board that I am in the habit of using for this purpose I propose to describe later, but I may perhaps here say that it is convenient to combine with the actual panels for distribution a special charging panel and also a panel to afford a simple means of connecting the groups of cells in parallel for obtaining large currents in those cases where such an arrangement is necessary, which will be more particularly the case in chemical laboratories.

Circuits.

Now as regards the circuits themselves, what type of conductor is the most suitable to employ ? The choice lies between insulated conductors and bare conductors, and I propose to show that the use of the latter is far more satisfactory from every point of view. The advantages chiefly lie in the cost of material and erection, and in the facilities afforded for making alterations and additions, such as

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tapping off extra terminal positions. Suppose we consider the necessary conductor required to carry 25 amperes. If we use an insulated conductor we should naturally work to the rules of this Institution, and the size of conductor for this current would be ⅛. Now in the case of a bare conductor we can work at a much higher current density, and we have merely to consider what limits of heating in the conductor we can allow and the corresponding drop in pressure at the end of the line. Some years ago, in order to arrive at a satisfactory current density to be used for bare conductors, so as to allow of reduction of weight to a minimum and still not to risk any undue heating, a series of experiments were made and the following formula was finally decided upon to be used for laboratory circuits :—

$$C^2 = 15\ D^3,$$

where C is the current in amperes and D the diameter in millimetres.

This formula gives us 22·7 amperes for a No. 10 S.W.G. wire. The drop in voltage per 100 ft. double run is therefore, in this case, nearly 2·9 volts. It may be of interest to add that a No. 10 bare copper wire will rise 18° F. from 75° F. in a room when carrying 26 amperes. Whereas to produce the same rise in the open air on a calm day in summer 42 amperes are required (see "Modern Electric Practice," vol. iii., p. 79).

Now we see from the above that we have to compare a bare No. 10 copper wire with a ⅛ cable as regards cost, the price of the former, taking copper at 9d. per lb., being about 12s. per 110 yards, and of the latter about £5 per 110 yards. Again, in erection it is not at all objectionable to run your bare conductors overhead, spanning from point to point to obtain the shortest runs. It will, I think, be admitted that this is hardly feasible with insulated cables of ⅛ and above. So that in addition to the saving on the conductor, we shall most probably use a smaller length of bare conductor for any particular circuit. The great point in using bare conductor is to have a really first-class insulator, and if the conductors are carefully erected, you can rely on obtaining a very high insulation resistance in a dry building. As an illustration in a laboratory that has been recently equipped, an insulation resistance of over 100 meghms has been obtained on each individual circuit, which is satisfactory taking into account that the conductor will on the average be carried on at least a dozen insulators and possibly pass through several walls.

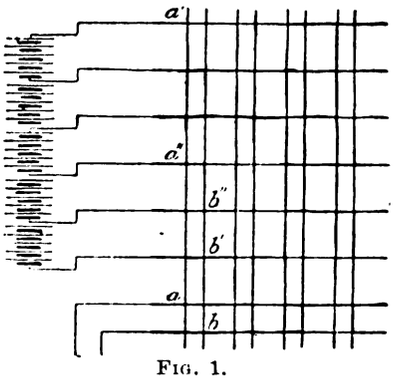

FIG. 1.

Reverting for a moment to the voltage drop in connection with those circuits where a low voltage is likely to be used. In most cases where low voltages are required, and by low voltage I mean up to 10 volts, the current used for an experiment is not likely to exceed 5 or 6 amperes. Supposing, however, we take a demand of 10 amperes, at 10 volts we get with our No. 10 copper conductor on a circuit of 100 ft. run (and very few runs are likely to exceed this length) a total drop on lead and return of 1·27 volts and at 6 amperes, the drop would only be 0·76 volts.

We will now consider the arrangements for distribution.

DISTRIBUTION.

Take first the simplest case where we desire to attribute currents from a battery of, say, 30 cells, giving steps of 10 volts. We divide the battery into groups of cells, in this case six groups of five cells each. Therefore, by placing one or more groups in series, we get 10, 20, 30, 40, 50, and 60 volts available. Now, if we have a panel with seven busbars connected, as shown in Fig. 1, to the cells, by connecting the ends of any circuit to two of these busbars we place on that circuit the voltage corresponding to the position of those bars.

Instead of using switches the most convenient arrangement is to have a series of horizontal and vertical bars drilled at each intersection and fitted with plugs to make contact between a horizontal and vertical bar. Fig. 1 shows diagrammatically such a board fed by five groups of cells and distributing to four circuits. Here we see an arrangement by which we can distribute current from the cells to any of four circuits at voltages varying from 10 to 50 in 10-volt steps.

It is, however, convenient to be able to charge the cells without having to disconnect the plugboard. For this purpose we then add two more horizontal bars, which bars are connected to the dynamo through the usual apparatus such as automatic cut-out, ammeter, etc.

Referring to the Fig. it will be seen that by inserting plugs at *a*, *a'*, and *b*, *b'*, we can charge the whole battery or we can pick out a single group to charge by inserting plugs at *a*, *a''*, and *b*, *b''*. It will be noticed that with this arrangement we can also place current direct from the dynamo on to any of the circuits.

The next arrangement is to have means available for connecting up the group of cells in parallel for use on a special circuit. This is effected by the device shown in Fig. 2. Here we have a pair of leads brought from each group of cells to the plugboard instead of connecting all the groups together in series at the battery. We split the horizontal bars in two pieces and interpose a single-pole switch between the two portions. Referring to the Fig., you will notice that

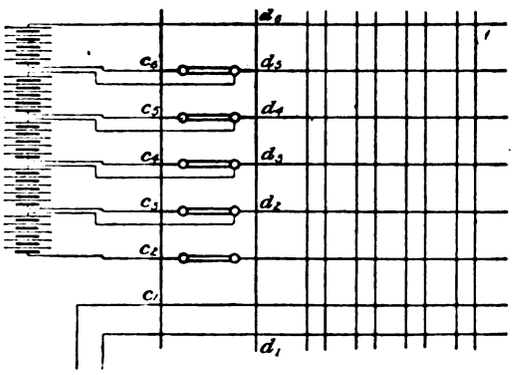

FIG. 2.

so long as all the switches are closed we have all the groups in series as before, and for using the four circuits we proceed in the same way as in Fig. 1. If, however, we wish to have the groups in parallel on to the special circuit we simply open all the switches and insert plugs at points marked C_1 to C_6 and D_1 to D_6. As far as connections for charging are concerned we use these same plug positions. Thus to charge the whole battery we keep all the switches closed and plug at C_1, C_2, D_1, D_6 ; or, supposing we desire to charge the third group from the top, we open the second and third switches and plug at C_1, C_4, D_1, D_4. Now, in a great many cases it is convenient to have two separate batteries, so that one battery is always available for discharge. In this case we have to devise an arrangement so that one battery can be charging whilst the other is discharging and *vice versa*. This arrangement is effected as shown in Fig. 3. Here on the charging panel we have two identical sets of bars and plug on each side of a vertical row of double-pole change-over switches. The centre short bars are so arranged that when all their plugs are inserted we have the corresponding cells all in series. The object of these short centre-bars is to enable a single group or number of groups to be selected for individual charging. By means of the change-over switches in the centre it is possible to connect either battery to the distributing panel, and the complete arrangement enables the one battery or any part thereof to be charged simultaneously with the discharge of the other or any part of it. Referring to the Fig., supposing we desire to charge the whole battery on the left and take a discharge from the battery on the right, we place all the change-over switches to the right, which entirely disconnects the left battery from the distributing panel and at the same time places the right battery in connection with that panel. We then insert plugs at *a*, *a'* and *b*, *b'*. Or supposing it is necessary to charge the second and third groups from the top, we take

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out plugs at X_4, X_1 and plug at a, a'' and b, b''. Conversely, if the battery on the right is to be charged and that on the left discharged, the change-over switches are placed to the left and the corresponding plug contacts made as before. Either set of groups of cells can be placed in parallel as described previously.

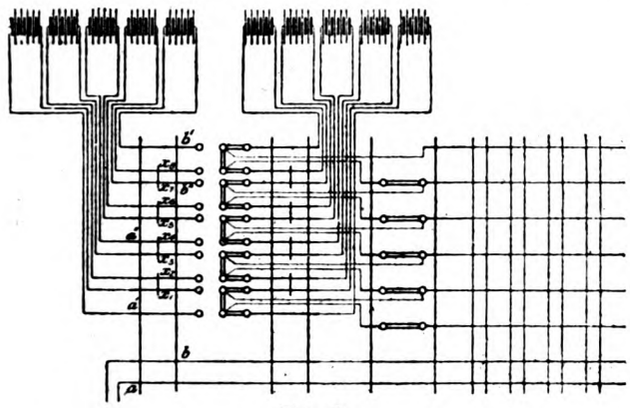

FIG. 3.

Summarising the above: A board, as indicated in Fig. 1, gives a method of placing different voltages from a number of groups of cells or direct dynamo current on to a number of circuits and affords means of charging the whole battery or any part thereof.

A board, as indicated in Fig. 2, gives method of placing different voltages from a number of groups of cells or direct dynamo current on to a number of circuits or of placing the groups of cells in parallel on to a special circuit together with arrangements for charging the whole or any part of the battery.

A board, as indicated in Fig. 3, gives a method of placing different voltages from a number of groups of cells in either of two batteries on to a number of circuits or of placing the groups from either battery in parallel on to a special circuit, also of charging either battery or any part thereof and of placing direct dynamo current on to any circuit. And it is further to be noted that one battery can be charging simultaneously with the discharge of the other.

In a large laboratory it may not always be convenient to run every circuit back to the main distribution board, but this difficulty is easily overcome by using additional plugboards to further subdivide the circuits. This branch board will be merely a repetition of that shown in Fig. 1.

Now, as regards the connection of circuits to the plugboards, I have adopted two different methods. In the first two series of busbars are used arranged at right angles to one another on either side of an insulating slab. What may be called the feeding busbars are placed horizontally at the back, and the distributing busbars are placed vertically on the front. A hole is drilled through both bars and the slab at each intersection, and a plug can then be inserted where desired to connect the front and back bars together. The circuit wires are connected through fuses to the ends of the vertical busbars. These plugs have presented some little difficulty. It is of great importance that the contact should be electrically and mechanically sound, and that the contact between back and front bars should be made expeditiously. The first two objects can be attained with a plug having a screw connection at one end and a cone at the other, but this is expensive. It means, firstly, an expensive plug, and it necessitates tapping the holes in the back bars and providing the front bars with coned seatings. You may be able to rely upon the screwed contact, but the cone and its seating are liable to wear and finally to become unsatisfactory. The next type of plug, consisting simply of a brass sleeve split at each end, does away with the objection of having tapped holes and coned seatings, thereby saving expense. The plug itself is also reasonable in cost and is, further, quick in manipulation, but though fairly reliable as regards contact it is not entirely so. Both these types of plug are in use, but the final type of plug, which I now use exclusively, is most reliable and inexpensive. You will notice that it consists of a brass sleeve internally tapered towards each end. Through the centre runs a spindle on which work two coned pieces of brass on a right and left-handed thread. The spindle is rigidly connected to the handle, which, when rotated, causes the two cones to move inwards, thereby pressing the ends of the sleeve, which are split to allow of expansion outwards. The rotation of the handle after the plug has been placed in position in the holes causes the plug to expand inside the holes. With this plug only parallel holes are required, and the contact obtained is electrically and mechanically perfect.

We now come to the second method of connecting the circuits to the boards. The advantages of the second method about to be described lie chiefly in a saving of cost in manufacture of the boards. In this method the vertical busbars are entirely dispensed with, and the horizontal bars are placed on the front of the slab. The circuits themselves are brought down to a fuse panel, and flexible cords are brought from the underside of the fuses over a system of pulleys and counterweights to appropriate positions on the front of the slab, so that the plug connected to the flexible can be connected to the busbars as required. The plug in this case has only to make a single contact and is constructed on the same principle as the double contact plug, but with a single internal cone working on the spindle. The saving in cost of this type of board is effected through the saving of the circuit busbars, and the saving in drilling of the slab, the latter being a considerable item. The saving here indicated more than compensates for the cost of the pulleys and counterweight gear. The chief difficulty with this design arose in connection with the flexibles. Great difficulty was experienced in obtaining a flexible conductor to carry up to 50 amperes sufficiently flexible to run nicely over a 3 in. pulley. Several makers in this country were tried without success, but a flexible conductor was finally obtained in Germany consisting of 3,081 strands of No. 48 S.W.G. The conductor is not insulated but merely covered with a braiding of soft cotton as it was decided to trust to the pulleys for insulation. This decision has been justified as on the circuits, as mentioned earlier in this paper, an insulation resistance of over 100 megohms has been obtained including the flexibles themselves, which will be roughly $2\frac{1}{2}$ yards long from fuse to plug. The pulleys are made of lignum vitæ with brass bushes working on a steel shaft.

I propose now to describe one or two arrangements which have been adopted for special purposes in connection with distribution of current. In the first place, it may be of interest to describe a device designed to prevent plugs being inserted into wrong holes on distributing panels.

Supposing we take the case of a distributing panel for eight circuits, that means we have 16 busbars, and in this particular case we arrange that the vertical circuit bars shall be at the back and the horizontal feeding busbars on the front. We desire to ensure that one plug only can be inserted in any horizontal bar at the same time. For this purpose we have an ebonite guard bar fitted between the busbar and the slab and free to slide backwards and forwards parallel to its length. There are the same number of holes in the ebonite bar as there are in the horizontal brass bar, but the holes are so spaced that when one hole in the ebonite bar corresponds with a hole in the bras sbar, and so allows a plug to go through both, all the other holes are out of adjustment. The spacing of the holes is found as follows: Suppose we space the holes in the brass bar at $1\frac{7}{8}$ in. centres. We have 16 holes, so that the total distance between the two extreme holes is $15 \times 1\frac{7}{8}$ in; if we take $\frac{16}{15}$ of this length and divide the result by 15 we get as the result 2 in., which will be the spacing for the holes in the ebonite bar. And it will be found that this spacing satisfies the condition required.

The second special application of plugs that I propose to describe is an arrangement for high tension work to prevent accidental contact with busbars carrying a high tension current. We have a plugboard arranged to place four sections of a transformer secondary in series or in parallel. Assume the transformer primary to be fed by a single-phase alternating current at 100 volts, and that the secondary is split into four equal sections, each giving 250 volts. These four sections are connected to a board arranged as indicated on the wiring diagram, Fig. 6, in the top right-hand corner. by eight conductors, and by means of double contact plugs these four sections are connected up in series to give 1,000 volts to the external circuit, in parallel to give 250 volts, or in multiple series to give 500 volts. Such an arrangement might be a source of danger to students, so a guard device is necessary to prevent accidental contact with the busbars. In the first place, a sheet of plate glass, perforated with the necessary holes to allow of the insertion of plugs in the

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proper positions to obtain the required voltage, is fitted on the front of the board. The double contact plugs are fitted with elongated handles in which are cut circular grooves. An ebonite bar, pivoted at both ends and therefore free to move about an axis parallel to its length, is provided at proper intervals with slots, which engage with the grooves in the plug handles. One end of the ebonite bar is connected by means of a link with the handle of a double pole switch, which is placed into the primary circuit of the transformer, and is so set that when the switch is closed all the plugs are locked by the ebonite bar and can only be moved after opening the switch. Thus when the busbars are alive the plugs can neither be inserted nor withdrawn.

Generally speaking it is obvious that a combination of plugs and switches can be arranged to meet almost any desired purpose, and I should like to point out the very great convenience arising from these arrangements in laboratory work. There is a great saving of time and trouble in being able to set your connections in a simple way by means of these plugboards, instead of having to work with loose wires and cables.

Terminals for Connecting Apparatus to the Circuits.

In designing the general scheme for a laboratory we have to consider the requirements of three classes of students :—

1. Elementary.
2. Advanced.
3. Research.

1. The requirements for elementary students are for most purposes met by small portable batteries. But it is convenient to have circuits available for use from the central distribution system as well. It is not necessary to provide the elementary laboratory with a large number of independent circuits, as the experiments conducted by these students can be performed very well off a single circuit or possibly a pair of circuits. The current required by each student will be small and the voltage low. The most convenient arrangement is probably to feed the elementary laboratory with a couple of 50 ampere circuits, and arrange a series of tappings off the circuits, whose number will depend on the number of students working together in one class.

2. In the case of more advanced students it is best to set apart a number of circuits for their exclusive use, feed these on to a separate plugboard, and wire the necessary number of terminal positions off this plugboard, arranging so that not more than two students are working off the same circuit simultaneously.

3. For research work it is advisable that each terminal position should be an entirely independent circuit, so as to ensure absolutely steady currents and avoid any risk of the circuit being interfered with by another experiment.

Capacity of Circuits.

The capacity of the various circuits must depend upon circumstances in each particular case, but generally speaking, physical laboratory circuits are best arranged for 20 and 50 amperes, and those in chemical laboratories for 50 and 100 amperes.

Special Conductors.

In certain rooms of a physical laboratory it is necessary to eliminate all possible magnetic effects from the circuits. This can be attained either by crossing the conductors at short intervals, or by changing from bare conductors to insulated concentric cables.

For furnace and other heavy current circuits copper strip may be conveniently used, fitted on iron brackets with the usual pattern of busbar insulator. A current density of 2,000 amperes per sq. in. may be used, as a drop in pressure is not material, and these circuits are usually very short. For the lecture tables it is best to bring the bare copper as close to the table as may be conveniently, and then finally connect up to the terminals on the tables with insulated conductor.

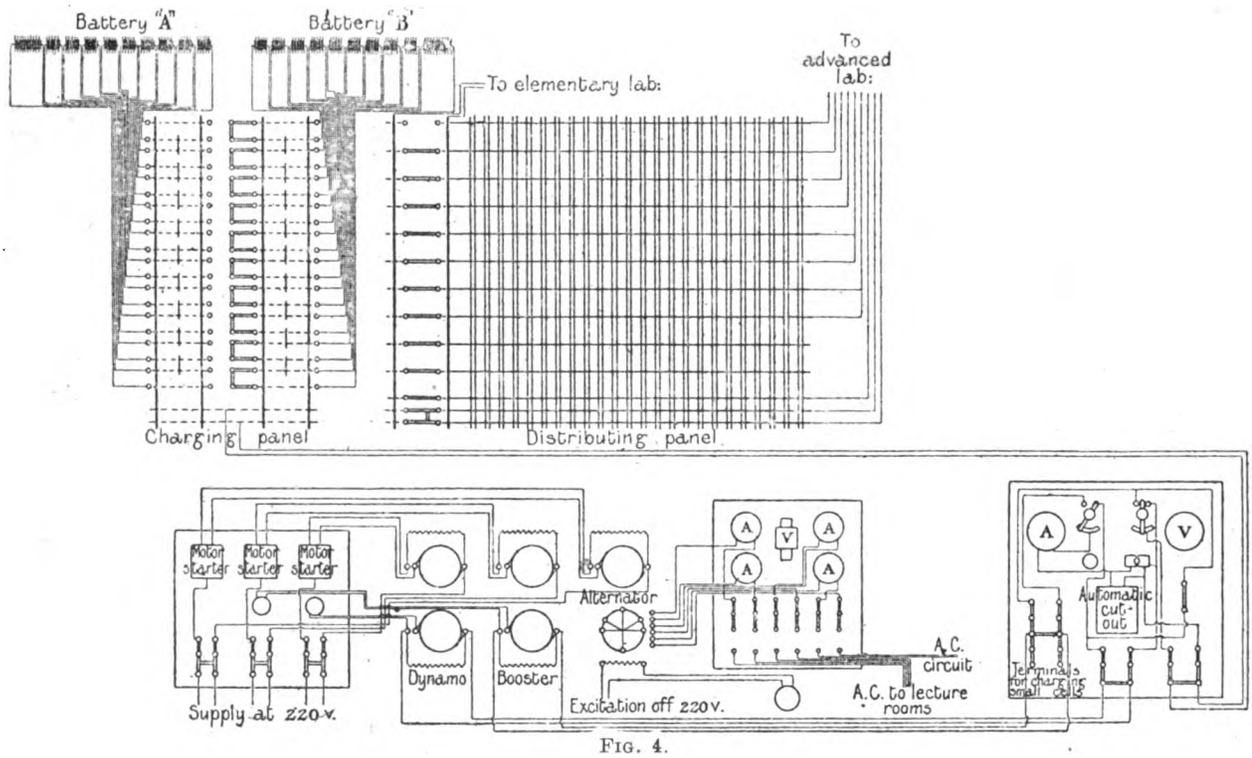

Fig. 4.

The following paragraphs contain short descriptions of recent laboratory equipments in which the foregoing principles have been embodied :—

Case A.—Physical Laboratory.

Supply : 220 volts direct current, 3-wire system, 440 on outers.

Source of current :—

Dynamo driven by 220 volt motor, 80 amperes, 110 volts.

Dynamo driven by 220 volt motor, 80 amperes, 30 volts.

Alternator driven by 220 volt motor fitted with six slip-rings, for 1-,2-, or 3-phase current :—

Single-phase, 17 amperes, 140 volts.
Two-phase, 11 amperes, 140 volts.
Three-phase, 14 amperes, 120 volts.

Two batteries of 55 cells, 200 ampere hour capacity.

The dynamos and cells are connected to a main plugboard of the type shown in Fig. 3. There are 24 circuits distributing current through the laboratories. In the advanced laboratory there is a sub-board off which 12 circuits are taken for the advanced students. One large circuit feeds the elementary laboratory with a series of tappings to feed the various benches. The conductors are of bare copper,

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except in the elementary laboratory, where the conductors are laid in trenches in the floor and are therefore insulated. The cables are insulated with vulcanised bitumen, as are also the cables which feed the terminals on the lecture tables.

CASE B.—CHEMICAL LABORATORY.

Supply: 220 volts direct current, 3-wire system, 440 on outers.

Source of current:—

Two dynamos driven by a single motor off 440 volts, the three machines working on one shaft with the motor in the middle. Output of each dynamo, 50 amperes, 65 volts.

board, shown in Fig. 2, and also to a sub-board of the type shown in Fig. 1. Off the main plugboard there are 24 circuits, four of which feed a second sub-board for the lecture-room circuits. In addition a special 4-wire circuit feeds the physico-chemical laboratory, the four wires being connected to the four top busbars of the main board. As these four busbars are connected to the first three groups of cells, consisting of two, four, and six cells respectively, we can obtain on this 4-wire circuit 4, 8, 12, 20, or 24 volts. The alternator is connected to a plugboard, which enables the four armature sections to be connected as required to the heavy current circuit. This circuit, which runs to those positions where furnace operations are to be performed,

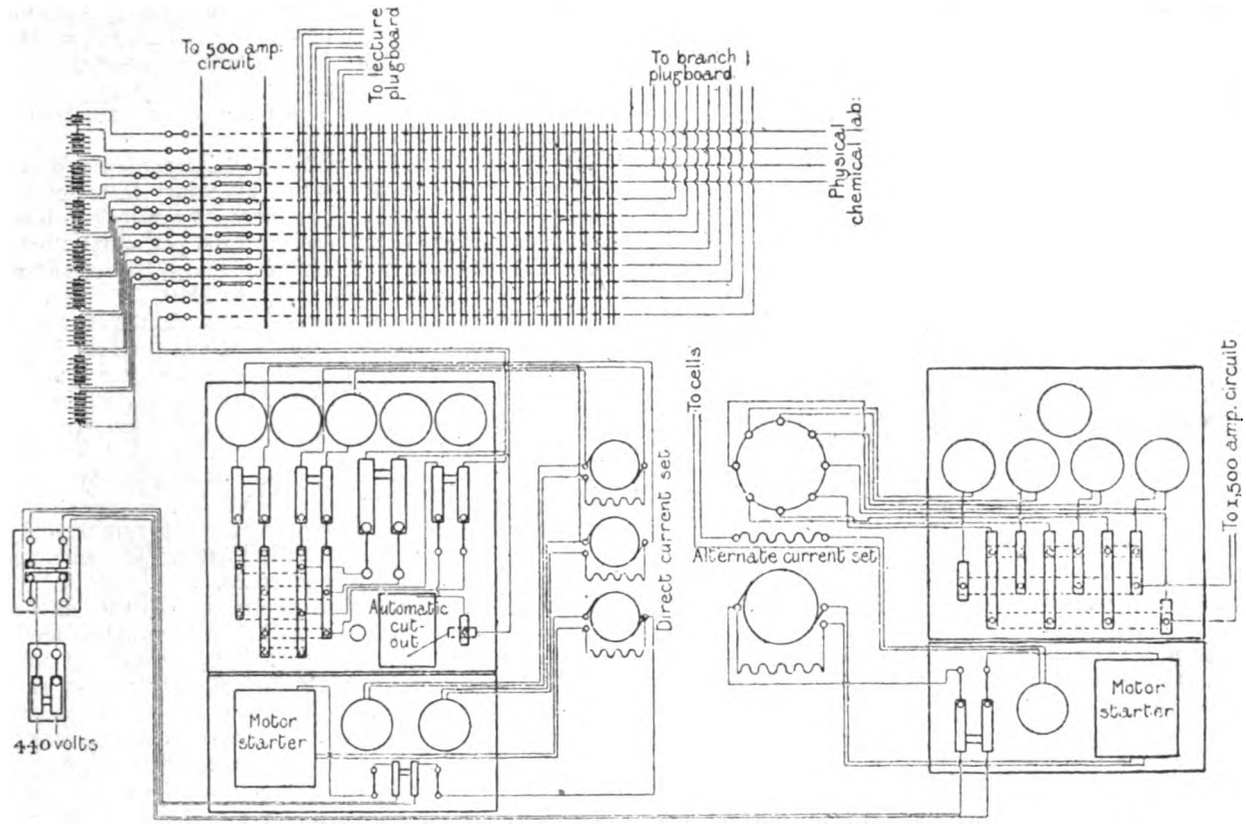

FIG. 5.

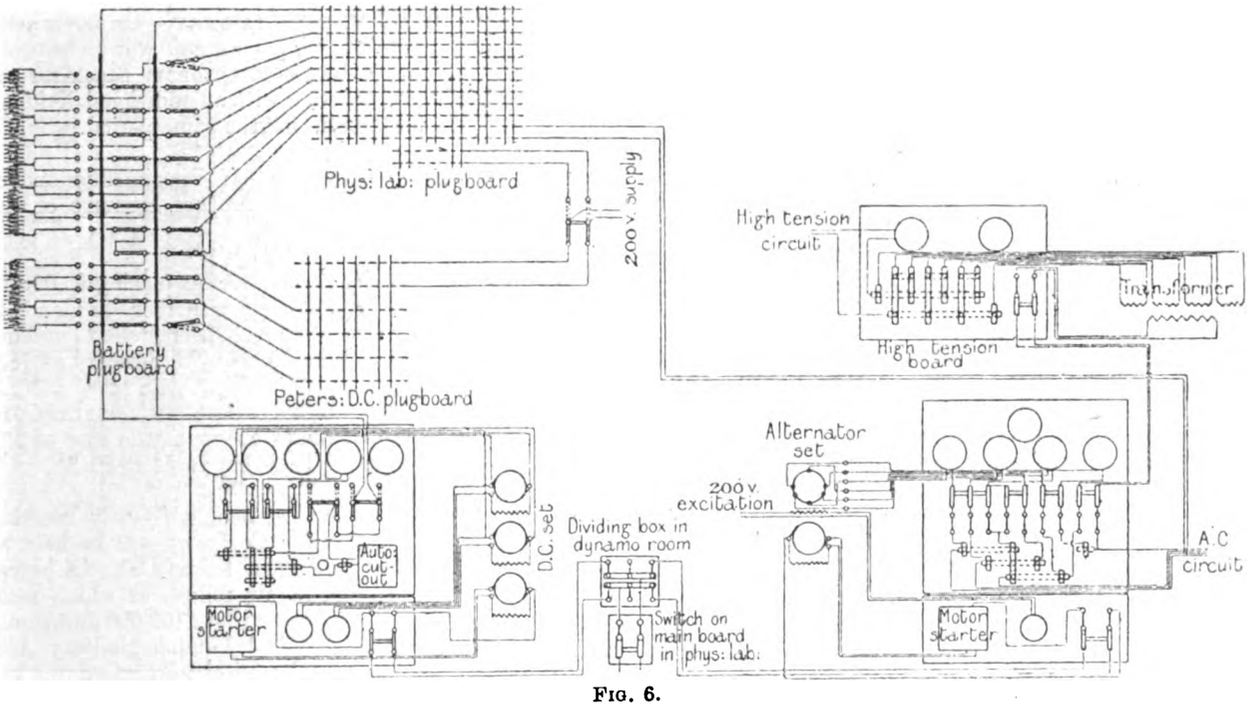

FIG. 6.

Single-phase alternator driven by 440 volt motor, having total output of 35 k.v.a. with armature in four sections to be connected in series or in parallel.

One battery of 48 cells, 220 ampere hour capacity. The battery is divided into nine groups of cells, seven groups of six cells each, one group of four cells, and one of two cells. These groups of cells are connected to a plug-

consists of copper strip of section 2 in. by $\frac{3}{8}$ in. All the conductors are of bare copper, with the exception of the conductors feeding the lecture tables, which conductors are insulated with vulcanised bitumen.

CASE C.—PHYSICAL AND ELECTRICAL LABORATORIES.

Supply: 200 volts direct current, 3-wire system, 400 on outers.

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Source of current :—

Two dynamos driven by a single motor off 400 volts, the three machines working on one shaft with the motor in the middle. Output of each dynamo, 40 amperes, 65 volts.

Alternator fitted with six slip-rings driven by 400 volt motor.

Output : Single-phase, 60 amperes, 100 volts.
Two-phase, 30 amperes, 100 volts.
Three-phase, 38 amperes, 90 volts.

One battery of 50 cells, 240 ampere hour capacity.

There are two different buildings here, one for pure physics and one for electricity. All the plant is situated in the electric laboratory. The battery is divided into 10 groups of five cells each, seven of these groups are for use in the physics laboratory, and the other three for use in the electric laboratory, but arrangements have been made so that the whole battery is available in either building. In the physics laboratory there is a distributing plugboard of type shown in Fig. 1, fed by seven groups of cells from the electric laboratory, but in addition to the current from the cells arrangements are made on the plugboard for distributing alternating current from the alternating-current machine and also current from the 200 volt supply mains. It is to be noted that this board is fitted with ebonite guard-bars described earlier in this paper. Off this board there are eight circuits for feeding the various rooms of the physics laboratory.

The electric laboratory has a small plugboard fed by three groups of cells, and also with arrangements for current from the 200 volt mains. Off this board there are three circuits for the rooms of the laboratory. The alternator is connected up to a switchboard, and off the switchboard there are two circuits, one a 2-wire circuit which runs to the high tension room where it feeds a transformer, the other a 4-wire circuit which runs to the alternate-current room, and enables either 1-,2-, or 3-phase currents to be used there. The transformer just mentioned in the high tension room is a single-phase transformer fed at 100 volts on the primary, and with the secondary divided into four similar sections, each giving an output of 6 amperes at 250 volts. Eight leads are taken from the secondary to a board, where they can be connected up as required.

Three general diagrams, Figs. 4, 5, and 6, indicate the connections adopted in the three cases just cited, from which diagrams a clear idea of the laboratory installations may be obtained.

A "METALITE" DEMONSTRATION.

The remarkable success, both scientific and commercial, of the new metallic filament lamp, was marked on Monday, by the invitation by the Bryant Manufacturing Syndicate, Ltd., to representatives of the Press to an inspection of the firm's new works, which have been erected to cope with the requirements of the increasing demand for the "Metalite" speciality described in the columns of our last week's issue.

The guests invited, to the number of upwards of 150, assembled shortly before noon at the Hotel Cecil, where they were received by the directors of the Syndicate, immediately afterwards proceeding in motor cars to the new Horsill Works, Highbury, N. The premises, which have been specially designed on the most up-to-date lines for the particular requirements of the new industry, occupy a commodious site in the northern suburb, and have been equipped with special machinery and plant erected without regard to cost, to facilitate manufacturing operations on a scale commensurate with the rapidly growing demand for the "Metalite" production.

The visitors were received by Mr. E. Harrison, A.M.I.E.E., the chief engineer, who illustrated in a series of interesting tests the high qualities of the new filament in illuminating power. The demonstration also included a remarkable test of an improvement in an automatic switch, which was attached to a "Metalite" lamp, operating eight times in every minute. Calculating to date the switch has already operated about 200,000 times, yet the lamp is in no way affected.

At the conclusion of the demonstration the party returned to the Hotel Cecil, where, by the invitation of the directors, they were entertained to luncheon, Col. Kinloch, C.B., M.V.O., Chairman of the Syndicate, who presided, proposing the toast of "the King." Sir Thomas Brooke-Hitching, in felicitous terms, offered a similar compliment to the Press, to which Mr. Peal and Mr. Rendell, editor of "Electricity," responded, and the proceedings then terminated.

PERSONAL.

The Birmingham City Council have appointed Mr. Howard Foulds to the position of Secretary of the Electric Supply Department at a salary of £600. For the past 16 years Mr. Foulds has held the position of Secretary to the Faraday House Electrical Standardising, Testing and Training Institution, and, in addition to this, he has served as a member of the Holborn Borough Council, and as a Poor Law Guardian to another London Borough. Three hundred and twenty-two applications were received for the post.

Mr. G. F. Craven, Assistant Engineer of the Reading Corporation Tramways, has had his salary increased from £160 per annum to £180 per annum, to rise by two further annual increments of £10 each to £200 per annum.

Mr. T. Hall, assistant electrical engineer, Burton Borough Works, has had his salary raised to £170.

The Admiralty has awarded the New Admiralty Scholarship in Electrical Engineering, instituted in May last, for the especially able and deserving electrical fitter apprentice in the Royal Dockyards, to Mr. W. H. Chatten, of Sheerness Dockyard, the electrical fitter apprentice who obtained the highest marks at last year's examination of the Dockyard schools. Mr. Chatten proceeds to the Royal Naval College, Greenwich, for a year's study in electrical engineering, and will receive an allowance of £40 per annum and the minimum pay of a hired electrical fitter. The scholarship may be extended for a second year.

According to advice from Melbourne, Messrs. Staerker & Fischer, agents for the "A.E.G.," have added another engineer to their technical staff in the person of Mr. B. Wood, who comes direct from the headquarters of the "A.E.G." in Berlin. Mr. Wood will act as first assistant engineer to Mr. J. M. Jolly, who is chief engineer and manager for the Melbourne office of the firm.

FINANCIAL NOTES.

British Columbia Electric Railway.—On 30th inst., a dividend at the rate of 5% per annum will be paid on the 5% Non-cumulative Preferred Ordinary Stock for the half-year ended 30 ult., together with an additional dividend at the rate of 1% per annum for the same period.

* * *

Lisbon Electric Tramways.—An interim dividend of 3% (free of income tax) on account of earnings of the current year has been declared.

* * *

Direct United States Cable.—After placing £5,000 to reserve, the directors recommend a further dividend of 4s. per share, together with a bonus of 2s. per share, making 4½%, for the year ended June 30, carrying forward £4,783.

* * *

Bournemouth and Poole Electricity Supply Company.—Interim on the Ordinary shares at the rate of 5% per annum, less tax, for the half-year to June 30.

* * *

Central London Railway.—The half-yearly meeting of the Central London Railway Company will be held at the Holborn Restaurant on August 4, at 12.30. An extraordinary meeting will immediately follow, at which resolutions will be submitted proposing that £150,000 additional capital authorised by the Central London Railway Act, 1902, and £330,000 additional capital authorised by the Central London Railway Act, 1909, be raised by the creation and issue of new 4½% Preference stock. It is also proposed that the company be authorised, in respect of the £150,000 additional capital, to borrow on mortgage sums not exceeding in the whole £50,000, and in respect of the £330,000 additional capital to borrow on mortgage sums not exceeding £110,000. The transfer books will be closed from July 21 to August 4, both days inclusive.

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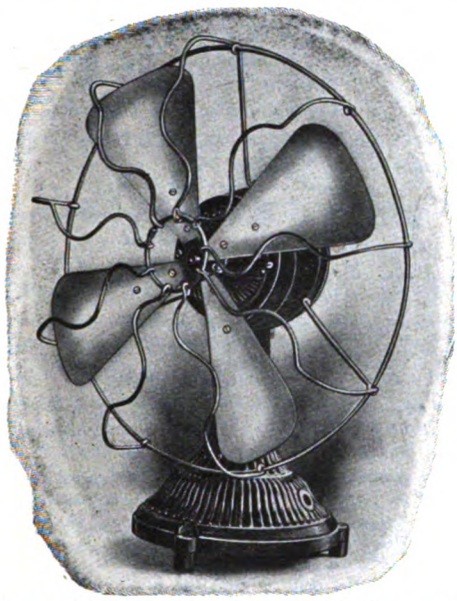
Electricity in the Summer Time.

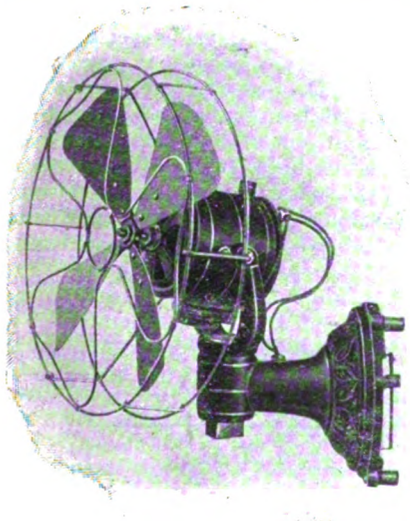
Fifth Article.

THE ARMORDUCT MANUFACTURING COMPANY, LTD., Farringdon Avenue, London, E.C.

This firm have a very comprehensive list of fans, including fixed desk, swivel and trunnion adjustable and bracket types, and those of the ceiling and port-hole kind. Our first illustration shows the swivel and trunnion fan, made



in four sizes—10-in., 12-in., 14-in. and 16-in.—and costing (for 100-150 volts) respectively £2 2s., £2 5s., £3 6s. and £3 9s. At 200-250 volts the prices are increased about 10%. The first three sizes are also made for alternating current, the prices being enhanced by about 15%. A very good pattern is the adjustable bracket fan, costing only a few shillings more. All these are fitted with speed regulators in base. A thoroughly practical combination



is shown in our third illustration, which depicts the "Tornado." This is a ceiling fan, with two 60-in. blades, set on angle, attached to a standard pattern small motor, combined with a 6-blade rotary fan. Thus action and reaction is secured. The reverse current which is created by the rotating fan forces the motor, with its attached large blades, into circulation, and in this manner air is moved on a very much larger area than is possible with a ceiling or pedestal fan of the ordinary type. A further important advantage is that the speed may be readily regulated by an alteration in the angle of the motor. The efficiency of the "Tornado" is greatly superior to that of any ordinary ceiling fan, with the result that it may be spaced at considerably greater distance where a number of fans are employed.

THE ECLIPSE ELECTRIC COMPANY, Bootle.

We give an illustration of the E.E. Company's vacuum cleaner. The body of the machine is of oak, walnut, or other woods to order. All working parts are enclosed, but the front of the machine being removable are readily accessible. The machine is fitted with two rubber tyred wheels so arranged that when it is tilted by grasping the handles, the wheels come in contact with the floor, and the machine can be pushed along smoothly from point to point. When the machine is in working position it presents in contact with the floor a large smooth surface, and cannot cause marks or damage. The machine is fitted with a double bellows, fixed at the centre, driven by means of a connecting

rod from a large pulley wheel, in turn driven by a leather belt from the motor pulley; the moving parts being plated and well lubricated. The motor is of the "Company's" V.C. type, compound wound, ¼ h.p. specially designed for this particular work. The motor is protected by a single, or D.P. fuse, and is fitted with an ordinary tumbler switch, this being quite sufficient for the purpose; also an ample length of flexible cord, with either lampholder or plug adapter, and runs from 4 to 5 hours per unit of electricity. A supply of nozzles is provided with the outfit as follows:—

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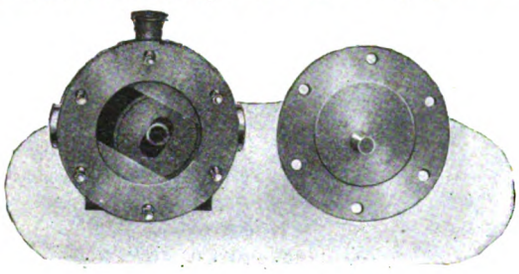
Floor or carpet nozzle, furniture nozzle, corner nozzle, wall nozzle, and curtain nozzle, and nozzles for special purposes can be supplied to order. Owing to the speed of the machine and double bellows being provided, the highest possible suction is obtained, such suction being practically continuous, and the machine will readily pick up small articles. The action of the machine is as follows:—The bellows exhaust the air from the vacuum chambers, causing a suction through the flexible pipe to which the various cleaning nozzles are attached; this draws in the air and along with it comes the dust, coins, etc.; the air passes to the bellows through a porous bag, which intercepts and retains the dust, etc., and the air is exhausted through the valves in the bellows. The dust bag is easily removable from the top of the machine, and lies immediately under the round cover, fixed by two thumb screws, through the centre of which the swivel receiving pipe is fitted. The suction flexible tubing is of large bore, and two 7-ft. lengths are supplied; also a nickel-plated extension tube, one end of which takes the various nozzles, or the nozzles can be fitted direct on to the flexible tubing. The dust bags are fitted with an air-tight rim, and the machine is fitted with an automatic release valve which acts in case the flexible tube should get blocked (a rare occurrence), or when the corner nozzle, which is all metal, is often unintentionally pressed up into some corner where it is impossible to draw dust or air, as in the case of same being pressed tightly against a wooden floor. The price is £21.

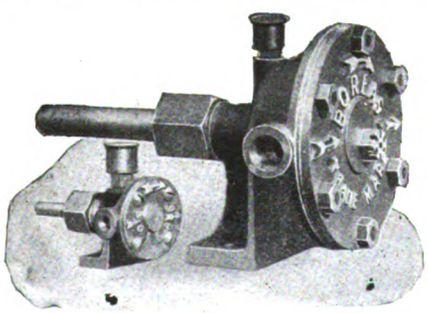
MESSRS. LACY-HULBERT & CO., LTD., 91, Victoria-street, Westminster, S.W.

The "Boreas" rotary pump is an efficient appliance reduced to the utmost expression of simplicity, for it has no gears or vanes and only two mechanically operated parts



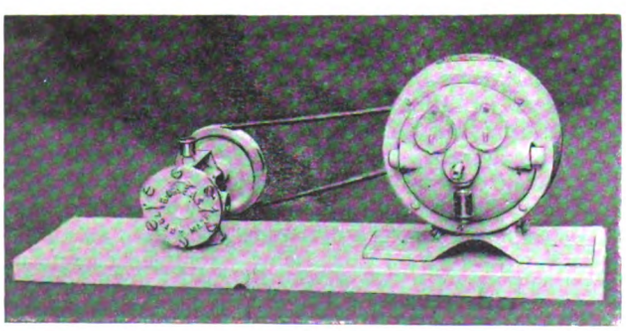
INTERIOR OF PUMP WITH END COVER.

and two bearings. Yet it will raise any liquid from considerable depths and propel it with great force. Moreover, its rotation can be reversed, while either with or without the



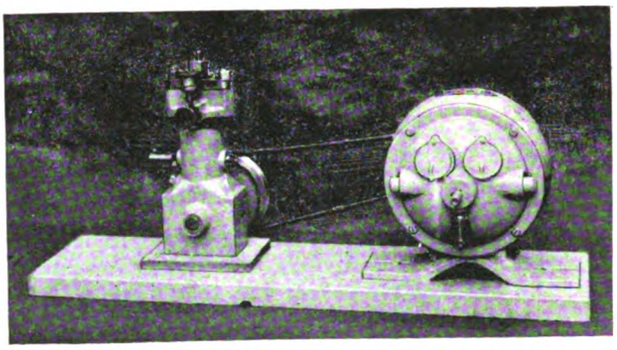
COMPLETE PUMPS, SIZES 1 AND 4.

action of the suction and delivery branches being reversed at the same time. It is certainly a reliable pump, of very great flexibility in action, and with practically nothing to get out of order. It is made in six sizes, rising in capacity



ELECTRICALLY DRIVEN

from 10 to 1,000 gals. per hour, and costing from £1 4s. to £7 10s. These pumps, which for capacities of 10, 40, 80 and 270 gals. per hour are made in gun metal, and for those of 500 and 1,000 capacity in cast iron, are also



ELECTRICALLY DRIVEN.

mounted on convenient carriages, and driven by small electric motors. Thus equipped they are most useful for country house and garden work, and also as fire engines. A large equipment of this kind, with a capacity of 1,500 gals. per hour, will cost about £42.

ELECTRIC CONSTRUCTION.

At the annual meeting of the Electric Construction Company, Ltd., Mr. Walter McLaren, M.P., presiding, said that whilst not so favourable as anticipated, the accounts were not unsatisfactory having regard to the conditions which had prevailed. He congratulated the shareholders upon the strong financial position of the company. They had no loans of any kind, and the realisable assets were many times greater than the current liabilities.

They had been able to redeem on favourable terms £40,000 of second mortgage debenture stock, and an annual sum of £1,800 hitherto paid as interest would become available for dividends. Out of the surplus arising from redemption £10,000 was placed to the credit of the general reserve fund. There was a further substantial amount at the credit of the suspense account.

The chairman alluded to the action brought against the company by a German firm for alleged infringement of a patent. There had been an appeal lodged by the plaintiffs, who were unsuccessful in the first action, and this will be heard at the end of the month. The board had credited a sum out of the surplus to the suspense account which would cover any loss, if the appeal was unsuccessful.

The position of the other companies in which they were interested had not materially changed. The Electrical Power Storage Company had made increased profits, but the board of that company deemed it prudent not to distribute a dividend. The proposed extension of the Madras tramways had not yet been sanctioned by the Government, but a marked improvement had taken place in the net receipts from existing lines. It would, however, be in the best interests of the shareholders in the tramways to retain their increased earnings in the business. They had no doubt of the ultimate ability of the undertaking to earn a reasonable return.

The report was adopted without discussion.

Sir James Pender and Mr. P. E. Beachcroft were re-elected directors, and Messrs. James Meston & Company, auditors.

The chairman at the close repeated his optimistic belief as to the company's prospects.

LEGAL.

Witney Electric Supply.

In the Chancery Division, Mr. Justice Swinfen Eady, on the motion of the plaintiff in a Debenture holder's action —Smith v. Witney Electric Supply Company, Ltd.— appointed a receiver of the company. Mr. Clausen, for the plaintiff, said the company was incorporated in 1899 and in 1902 created an issue of Debentures. The interest was not in arrear, but the case was one of jeopardy. The business of the company was now being carried on at a loss and the company would not be able to pay the interest due in December or to pay off the Debentures that fell due then.

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THE
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UNITED STATES: Mr. E. Brandon, 27, Thames Street, New York.

CANADA: Messrs. Walsh & Stoer, Stair Building, Toronto.

IMPORTANT NOTICE TO ADVERTISERS.

Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents and Small Advertisements by 9 a.m. on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements, 24 words 1s. per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

Situations Vacant, 24 words 1s., three insertions 2s 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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THE ELECTRICAL ENGINEER *can be had by order from any Newsagent in Town or Country, and at the various Railway Stations; or it can, if preferred, be supplied direct from the Office on the following terms:*

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United Kingdom ..	3s. 3d. ..	6s. 6d. ..	13s. 0d.
Other Places	5s. 6d. ..	10s. 6d. ..	21s. 0d.

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Bound volumes of THE ELECTRICAL ENGINEER, *containing half year's copies, bound in Dark-Blue Cloth, Gold Lettered, price* 8s. 6d.

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ELECTRICITY IN COAL MINES.

Such rapid progress is being made in introducing electricity practically for every phase of mining work that it is worth while to take stock of the present state of affairs. This has been admirably done so far as coal mining is concerned by Professor W. M. Thornton in "Coal Trade Pamphlets, No. 7." After briefly referring to the historical aspect of the question, the Professor boldly tackles the question of dangers and risks, and is rather inclined to favour a return to the old practice of the use of low pressure. Yet he goes on to say that in modern practice with high tension A.C. systems the risks of shocks are not increased in proportion to the voltage, partly owing to the knowledge that contact may be fatal and partly to the precautions taken to enclose live portions on switchboards or machines. The Professor pays welcome praise to the skill with which modern machines are designed and manufactured, and he favours motors of the three-phase type because, though involving more care in management (itself not an unmixed drawback, because entailing competent attendance), they are sparkless and have switch gear enclosed in oil. But, as we are reminded, after all, electrical accidents are relatively few. From the period 1903—1908, dealing with 6,981 cases of fatality to persons in or about mines under the Coal Mines Regulations Act, only ·83% were in any way due to electricity. In spite of the immense extension of the use of electricity, it is doubtful whether this percentage has been much increased within the period since then. We certainly agree that when carefully considered it will be found that "the combination of relative safety and efficiency, with readiness of control, makes electricity at its best the miner's friend." Where misconception chiefly arises is in relation to ignition of coal dust and firedamp. It is well that all suspicious cases should be closely investigated. We cannot follow here Professor Thornton's lucid record of the long series of tests so patiently carried out in regard to the ignition of coal dust; we must send our readers to the Professor's own pages, which deserve diligent

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perusal. The point of interest brought out is that ignition and explosion are due not so much to the energy of the flash as to its volume and duration. Another point is that risk is far less with the alternating than with continuous current. The same advantage is to be observed in the matter of blowing of fuses. It is proved that the percentage of ignition is four times greater with D.C. than with A.C. at 100 volts. These experiments have led to practical results in more than one direction; for instance, in designing of switch and distribution boxes with wide flanges. It is found that with a 2-in. wide flange the most violent explosion may take place within the box and yet no trace of flame be seen outside, because combustion cannot continue in the thin air space. Therefore, the Professor is emphatic in advocating the adoption of the metal-to-metal wide flange wherever possible. After what has been said, it comes with somewhat of a surprise to find Professor Thornton inclined to favour D.C. systems for non-gassy mines. His chief reasons seem to be its smooth running, but, above all, the perfection of leakage indication. The perfect leakage indicator for a three-phase circuit has yet to be devised. Partial as he is to the D.C. system, he recognises that "if electrical energy is to be used for all purposes in collieries, and economical transmission is in this case essential, it is difficult to see how D.C. can compete with alternating for large collieries or groups of collieries." Two drawbacks have, however, to be overcome. In practice, the drop of pressure in a small generator caused by switching on a large induction motor on load is excessive. The critic looks for the antidote to this in some such device as Mr. Miles Walker's phase-advancer. Secondly, there is too little flexibility as to speed of the induction motor; although, here again, the Professor sees a clearing of issues by the results obtained by adjusting brushes on certain commutator induction motors, which, he considers, should be given a good trial for haulage purposes. On the whole, then, the balance is in favour of further electrification, which should help both masters and men. For the purposes of inspiring confidence, we are told, qualified inspection is necessary, and to this end it is advocated that men possessing a knowledge of mining conditions, and who have specialised on the electrical side, should be appointed.

CATALOGUES AND PRICE LISTS.

The following catalogues and price lists have been received:—

G. Braulik: (1) The "Eclipse" semi-enclosed long-burning arc lamp, for D.C. and A.C.; (2) "Eclipse" Flame Arc Lamp, 1910 pattern; (3) Electric Light Cast Iron Watertight Fittings; (4) White Porcelain Insulators.

Siemens Bros. and Company, Ltd.: (1) Electro-Medical Apparatus, illustrated pamphlet; (2) X-Ray Tubes and Accessories; (3) Radium Salts and Applicators and Radio-Active Earths; (4) Precision Type Wattmeters and Transformers for Current and Pressure.

The Union Electric Company, Ltd.: (1) The "Kino" Cinematograph Lamp, hand regulated, for D.C. and A.C., illustrated leaflet with diagrams; (2) The "Excelsior" Patent Intense Flame Arc Lamp, with patent deposit-free globe; (3) Fortifer 3-phase Motor Starters.

Simplex Conduits, Ltd.: (1) Electrical accessories: Section A of illustrated general catalogue; (2) Fan circular folder, with post card, for use of dealers and contractors.

The General Electric Company, Ltd.: (1) "Freezor" electric fans: Section E of illustrated general catalogue, 1910; (2) "The 'General' Electrical Progress" for May, containing notes on novelties.

Smoke Consumption, Ltd.: (1) Illustrated leaflet of "Caloriser" appliances for obtaining completely smokeless combustion under boilers; (2) Illustrated leaflet of Auto-Air Regulator. Both of these are Cowper-Coles patents.

Underfeed Stoker Company, Ltd.: Illustrated catalogue of the Underfeed Stoker for the smokeless and economical combustion of all classes of coal.

Skefko Ball Bearing Company, Ltd.: Illustrated catalogue of Skefko ball bearings, showing their applications to all kinds of machines.

Eclipse Electric Company: (1) The "Whipple" Electric Tyre Pump; (2) Gas and oil engines.

Rhineland Manufacturing Company: (1) Leaflet, "The Theory of Ball Bearing"; (2) Cone bearings; (3) Ball swivel bearings; (4) Ball thrust washers and Ball thrust bearings. All illustrated.

Verity's, Ltd.: (1) Illustrated price-list "Starters and Regulators"; (2) Illustrated price-list, "Main Switches, Fuses, and Circuit Breakers."

J. Stottner, M.I.E.E.: Handsome illustrated catalogue of "Aliath" motors, generators and transformers.

T. W. Broadbent, Ltd.: Leaflet, M. type motors (encased).

PUBLICATIONS.

"Journal of the Institution of Electrical Engineers," June, No. 202, Vol. XLV.

Among the leading items of this number are Mr. E. A. Watson's paper on "Losses off Transmission Lines due to Brush Discharge," and Mr. F. Hope-Jones's "Modern Electric Time Service," Mr. A. G. Cooper's "Balancers for Three-Wire Systems," and Dr. R. Pohl's "Rating and Testing of Motors for Intermittent Working," together with the discussions.

"The Physical Review," June, 1910, No. 6, Vol. XXX.

Among the leading features of this number are "The Extra Transmission of Electric Waves," by F. C. Blake, and "Magnetostriction in Non-Carbon Alloys," by H. G. Dorsey.

"The Post Office Electrical Engineers' Journal," July. (London: Alabaster, Gatehouse & Co. Price 1s. net.)

Major W. A. J. O'Meara contributes an interesting account of his American tour, chiefly from a technical point of view; Mr. J. E. Taylor continues his "History of Wireless Telegraphy"; Mr. J. H. Thow gives a detailed account, with diagrams, of the new telephone installation at Harrod's Stores, and Mr. H. C. Gunton gives a paper on "Keen Curves, and the Economical Control of Intermediary Operated Electric Motors."

"Coal Trade Pamphlets." No. 7, 1d.; Nos. 8, 9 and 10, 3d.; No. 4, 1d. (London: "The Colliery Guardian.")

These three deal with the interesting subjects of "Electricity in the Mines," "Cost of Producing Coal" (three pamphlets bound in one), and "Industrial Diseases and Section 8 of the Workmen's Compensation Act, 1906."

ELECTRICAL HOSPITAL EQUIPMENT.—The Royal Surrey County Hospital, Guildford, has been fitted with a new X-ray and electrical treatment department as the result of a gift of £1,000 by Miss Helen Crooke, in memory of her father, Mr. F. A. Crooke, a former Mayor of the borough.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 139, Fleet Street, London, E.C.

CONTRACTS.

BELFAST HARBOUR.

The BELFAST HARBOUR COMMISSIONERS are prepared to receive TENDERS for the CONSTRUCTION, DELIVERY, SETTING IN PLACE, and TESTING in the ELECTRIC LIGHT STATION, Old Channel-road, Belfast, of an INDEPENDENT SURFACE CONDENSING PLANT, with OIL SEPARATOR, etc., and all requisite Accessories.

Outline, Specification, and Form of Tender, together with a Plan of the Station and any further information required, may be obtained from the Harbour Engineer, Mr. W. Redfern Kelly, M.Inst.C.E.

Sealed Tenders, on the special Form provided for the purpose, to be addressed to the undersigned, endorsed "Tender for Condensing Plant," and sent in on or before Wednesday, July 27, 1910.

The Commissioners do not bind themselves to accept the lowest or any Tender.

W. A. CURRIE, Secretary.

Harbour Office, Belfast,
July 13, 1910.

CHORLTON UNION.

REPLATING OF ACCUMULATOR.

The GUARDIANS OF THE POOR of the Chorlton Union are prepared to RECEIVE TENDERS (from Accumulator makers) for the REPLATING, etc., of the ELECTRIC ACCUMULATOR at the Cottage Homes, Styal, Cheshire.

Specifications and particulars may be obtained at the offices of Mr. F. W. Page, A.M.Inst.C.E., Consulting Engineer, Clarendon Chambers, 14, St. Ann's-square, Manchester, after the 18th instant, upon payment of £2 2s., which sum will be returned on receipt of a *bona-fide* Tender.

Sealed Tenders, endorsed "Tender for Replating of Accumulator, etc.," must be delivered to the undersigned, at the Union Offices, All Saints', Manchester, not later than Tuesday, July 26, 1910.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,

DAVID S. BLOOMFIELD,
Clerk to the Guardians.

Union Offices, All Saints', Manchester,
July 13, 1910.

PATENTS.

S. SOKAL, Chartered Patent Agent,

AND

Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.

55, CHANCERY LANE, LONDON, W.C.

THE PROPRIETOR OF THE PATENT NO. 18408 of 1906, for "Improvements in Electric Insulators for High Tension Conductors," is desirous of entering into arrangements by way of licence and otherwise, on reasonable terms, for the purpose of exploiting the same and insuring its full development and practical working in this country. All communications should be addressed, in the first instance, to—

HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
7 & 8, Southampton-buildings, Chancery-lane, London, W.C.

TENDERS ACCEPTED—Home.

LONDON.—County Council Tramways Department have accepted the tender of Messrs. Cammell, Laird and Company, Ltd., amounting to £219 1s. 8d., for the supply of (1) 24 pieces of mild steel 45¾ inches by 3¾ inches, (2) 50 P.W. axle forgings, and (3) 100 D.W. axle forgings for electric cars.

LONDON.—The County Council have received the following tenders for wiring and fittings for electric lighting installations at certain fire-stations:—Woolwich Fire Station—G. Weston & Sons, Ltd., 153, Fenchurch-street, E.C. (accepted), £185; E. Newbald & Company, Court-road, Sutton, Surrey, £186; Pinching & Walton, 52, Cannon-street, E.C., £192; John Barker & Company, Ltd., 83, Kensington High-street, W., £203 13s.; Tredegar & Company, 56, Victoria-street, Westminster, S.W., £270. Kingsland Fire Station—W. J. Fryer & Company, Bravington Works, Paddington, W. (accepted), £164 18s. 6d.; F. Troy & Company, 194, Finchley-road, Hampstead, N.W., £178; Alex. Hawkins & Sons, 125–128, London-road, Southwark, S.E., £195; John Bryden & Sons, 90, Gloucester-road, S.W., £200; G. E. Taylor & Company, 8, Bush-lane, Cannon-street, E.C., £221. Lewisham Fire Station—Tilley Brothers, 53, Kingsland-road, N.E. (accepted), £160 19s.; W. Leonard & Company, 4, Soho-street, Oxford-street, W., £165; Pinching & Walton, 52, Cannon-street, E.C., £204; Whitehead Brothers, 55, Berners-street, W., £228; G. E. Taylor & Company, 8, Bush-lane, Cannon-street, E.C., £234.

LONDON.—County Council received the following tenders for the supply of low-tension cables, cable boxes, etc., required in connection with the wiring for power purposes of the central car repair depôt:—Western Electric Company, North Woolwich, E. (accepted), £948 14s. 2d.; Johnson & Phillips, Ltd., Old Charlton, £979 12s. 2d.; W. T. Glover & Company, Ltd., Manchester, £1,004 9s. 2d.; Siemens Bros & Company, Ltd., Westminster, S.W., £1,011 12s.; W. T. Henley's Telegraph Works Company, Ltd., Blomfield-street, E.C., £1,016 2s. 7d.; British Insulated and Helsby Cables, Ltd., Prescot, £1,053 0s. 1d.; Callender's Cable and Construction Company, Ltd., Victoria-embankment, E.C., £1,053 4s. 6d. The Western Electric Company are to be allowed to sub-let to the under-mentioned firms (or to such other persons or firms as may be approved by the chief officer under the contract) the following portions of the work specified in the foregoing resolution (a), namely, (1) to Edison & Swan, United Electric Light Company, Limited, the supply of the three phase boxes; and (2) to W. T. Glover & Company, Ltd., the supply of the rubber cables. The installation of the low tension cables, etc., is to be carried out under the management of the Highways Committee by the direct employment of labour.

CONTRACTS OPEN.

HOME.

BARNET.—Guardians.—A, dynamos, motors, etc.; B, battery; C, wiring. Specification (£5) from Clerk, 12, High-street. July 26.

BELFAST.—Harbour Commissioners invite tenders for the construction, delivery, setting in place and testing in the Electric Light Station, Old Channel-road, Belfast, of an independent surface condensing plant, with oil separator and accessories. Particulars from the Harbour Engineer. July 27.

BELFAST.—Harbour Commissioners.—3¼ miles of 7/18 high-tension cable, paper insulated, lead covered, bound with a layer of jute, compounded, suitable for a 3,000-volt continuous current, and one mile of 7/18 rubber insulated cable. (Particulars, Harbour Engineer). July 27.

CHORLTON.—The Guardians invite tenders for the re-plating, etc., of an electric accumulator at the Cottage Homes, Styal, Cheshire. Particulars from Mr. F. W. Page, consulting engineer, 14, St. Ann's-square, Manchester. July 26.

CHELMSFORD.—Borough Education Committee invite alternative tenders for (1) supplying and fixing wiring for lighting by electricity; (2) supplying and fixing pipes for lighting by gas, at the Trinity-road Council School. Particulars from Mr. W. H. Pertwee, architect, The Institute, London-road, Chelmsford. August 31.

FINCHLEY.—Urban Council invite tenders for the supply of one Weir or Hall type boiler feed pump, capacity 5,000 gallons per hour, steam pressure 160 lbs. per sq. in. Particulars from the Council's Engineer, Squires-lane, Finchley, N. July 28.

LEITH.—Burgh Electricity Department.—One 500 kw. mixed pressure turbine and direct current generator, condensing plant, and cooling tower. (Specification, £1 1s., Burgh Electrical Engineer). July 25.

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Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

PLANT WANTED.

PLATINUM UTENSILS, SCRAP, LAMP TOPS.—Best prices given by DERBY AND Co., LTD., 44, Clerkenwell-road, London, E.C. N.B.—Platinum Sold.

AGENCIES.

LIBERAL COMMISSION is offered to an energetic and capable salesman calling upon users of nuts and bolts, to introduce a Patent that will save all users 75 per cent.—Address, B.C., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

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APPLICATIONS for Appointments effectively arranged, ensuring favourable consideration. Numerous unsolicited testimonials. Expert advice. Write now.—HERBERT GREATOREX, Beechwood, Matlock.

MEN OUT OF EMPLOYMENT in all branches of the Electrical Trade should write to Box No. 20, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

SITUATIONS WANTED.

MANUFACTURER'S REPRESENTATIVE desires change; London or Provinces.—Box A., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

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APPRENTICE-YOUTH, aged 16, seeks engagement, Electrical Engineer. North London preferred. Intelligent, good education.—R. C., ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

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JUNIOR SUB-STATION ATTENDANTS WANTED by three-phase London Railway; preference given to students of Polytechnic, Northampton and other Institutes. State age, experience and salary required, to Box 21, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WANTED, STOREKEEPER, accustomed to Electric Tramway, Lighting and Wiring Material and pricing of same. Salary 30s. per week. Only experienced man and good book-keeper need apply.—Box 22, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

ELECTRICIAN, 24, seeks re-engagement. Town or country. Six years' good all-round experience; good references. 46, Hill-street, Peckham.

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WANTED, a well-connected, sound, established BUSINESS, or a PARTNERSHIP would be considered.—Box No. 26, c/o ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

BOUND VOLUMES

— OF —

THE ELECTRICAL ENGINEER

Vol. XLV.

JANUARY to JUNE, 1910.

NOW READY. PRICE 8s. 6d.

APPOINTMENTS.

NORTHAMPTON POLYTECHNIC INSTITUTE, ST. JOHN-STREET, LONDON, E.C.

The governing body invite applications for the following appointments, to take effect after the coming vacation:

ELECTRICAL ENGINEERING DEPARTMENT.

SENIOR ASSISTANT to take charge of new Electric Generating Station. Full time. Knowledge of gas engines and of both continuous and alternating current machines and switchboards essential. Salary 45s. per week.

JUNIOR ASSISTANT for the above; chiefly to take charge of the Power Plant. Full time. Should have had experience in Central Station work. Salary 28s. per week.

SECOND LECTURE ASSISTANT. Full time. Salary £80 per annum.

MECHANICAL ENGINEERING DEPARTMENT.

ASSISTANT LECTURER AND DEMONSTRATOR. Full time. Salary £120 per annum.

Further particulars of the conditions of any of the above appointments can be had on application at the offices of the Institute, or of the undersigned; but applicants writing for particulars are requested to be careful to specify for which vacancy particulars are desired. All applications are required to be in at an early date.

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ASHTON-UNDER-LYNE: W. H. George & Sons, architects, 7, Warrington-street, Ashton-under-Lyne. Savings Bank.

BLAGDON: W. Rushworth, Shire Hall, Durham. Secondary School.

BRADFORD: C. Hicks, architect, 5, John-street, Adelphi, London. New church.

BRISTOL: H. Williams, architect, Alliance Chambers, Corn-street. Alterations of 1, 2, 3 and 4, Royal-crescent, Clifton, and conversion into flats.

CHICHESTER: It has been decided to rebuild the Infirmary at a cost of £20,000, half of which sum has already been promised.

EALING: C. Jones, Borough Engineer, Town Hall. New school.

EDINBURGH: A. H. Crawford, architect, 10, Randolph-place, Edinburgh. New Freemasons' Hall.

GLOUCESTER: Byard & Sons, builders, Stroud-road. School.

MORETONHAMPSTEAD: E. E. Ellis, architect, Exmouth. General Post-office and block of dwelling houses.

POCKLINGTON: Alterations to Grammar School.

OSWALDTWISTLE: W. Greenwood, architect, Victoria-street, Blackburn. Erection of Riding School and alteration to Territorial Headquarters.

TILBURY: W. Krance, Dock-road, Tilbury. Erection of Liberal Club; extension to Progressive Club.

WEST VALE, HALIFAX: C. F. L. Horsfall & Son, architects, Lord-street Chambers. Warehouse and stables.

NOTES.

Union Electric's New Lists.

Three new lists have been issued by the Union Electric Company, Ltd. The "Excello" flame arc lamp list supersedes No. 5009A, and the successful aim has been to make it more concise, and to arrange the information in a better manner for ready reference. We would specially draw attention to patterns USG and USW, which are fitted with a device for automatically cutting out the lamp should it for any reason fail to continue burning. On page 7 will be found illustrated some new reflectors and covers. List 6020, Section 5, relates to three-phase motor starters, and contains some new designs, notably, the star mesh switch on page 64. List 1409, devoted to cinematograph lamps, illustrates and prices a very useful little lamp, the main points of which are its great light-producing power with a small current (30 amperes). This is due to the special design of the carbon arrangement.

The Time to Buy Batteries.

With the present low prices ruling, owing to the depreciated market values of lead, the public are doing exceedingly

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
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well in placing their orders for storage batteries (a point contractors may find useful in canvassing). The D. P. Battery Company, Ltd., of Bakewell, are evidently sharing fully in the contracts obtainable, as amongst the many orders which are keeping their works busy they are now installing a second large battery at Letchworth for the First Garden City, Ltd., and have recently supplied three light and power batteries to the Midland Railway Company, the Melbourne Electric Light and Power Company, and the Blackpool Co-operative Society. In foreign trade they are just shipping five batteries, for India, China, New Zealand and the Argentine, and have even been able to ship to the United States, in spite of the tariff. In reference to the recent meeting of mining engineers just held in London, when a statement was made that storage batteries entailed the attention of a highly skilled engineer, whilst such services are admittedly desirable in the case of a large central station installation, it is estimated that in fully 95% of smaller installations batteries are in use without skilled attention with excellent results, as the working directions issued by the D.P. Company are simple and capable of being easily carried out. Wherever desired, the company's expert staff will from time to time inspect any of their installations.

Miniature Osram Lamps.

The General Electric Company have issued an excellent leaflet (No. S1412) describing and illustrating miniature Osram lamps, for use with dry batteries, pocket lamps, torches, hand and miners' lamps, accumulators, etc., as well as a special line of high candle-power round bulb lamps,

especially suited for motor-car use. We give illustrations of the round bulb and an "S. E. S." miniature lamp, the latter provided with an opal glass reflector. These are new departures which should find favour with an increasingly large public, and are certainly worth stocking.

Instruments of Precision.

With the approaching opening of the educational year, and the overhauling of central stations in preparation for the autumn and winter lighting campaign, Messrs. Siemens Bros. & Company's June, 1910, supplement to their catalogue of Testing Instruments, relating to precision type wattmeters and precision type transformers for current and pressure should prove of special interest. These instruments have been designed to meet the demand in connection with the continually increasing employment of alternating current, for portable apparatus to cover wide ranges of currents and pressures, such as are readily obtainable for direct current work. The instruments are exceptionally small, and therefore exceedingly portable, while the high accuracy of a first-rate sub-standard is ensured. The first part of the supplement deals with wattmeters, which are listed with pivoted and suspended movements.

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The Best and Cheapest In the End.

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Telephone: 136 Eastern.

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EXHAUSTING TURBINE ENGINES.

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Coppersmiths and Brass Founders,
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TECHNICAL CLASSES.

ENGINEERING AND CHEMISTRY.

CITY AND GUILDS OF LONDON INSTITUTE.

There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE.

(EXHIBITION ROAD, S.W.)

A College for higher Technical Instruction for Day Students not under 16 preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a "*School of the University of London*," and also forms the *Engineering Section of the Imperial College of Science and Technology*. The Entrance Examination includes the subjects of Mathematics, Mechanical Drawing, Physics, Chemistry, English Composition, and French or German Translation, and the Courses of Study for the Associateship of the Institute cover a period of three years. Fees, £36 per Session. Professors :—

Civil and Mechanical Engineering .. W. E. DALBY, M.A., B.Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering .. .. T. MATHER, Wh. Sch., F.R.S.
Chemistry .. .. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics .. O. HENRICI, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY.

(LEONARD STREET, CITY ROAD, E.C.)

A College for Day Students preparing to enter Engineering and Chemical Industries, and for those who have already served an apprenticeship, and also for Evening Students. The subjects of the Entrance Examination are Mathematics, and English Composition and Precis Writing. The Day Courses in Mechanical or Electrical Engineering cover a period of two years, and those in Chemistry three years. Fees, £20 per Session. Professors :—

Physics and Electrical Engineering .. .. SILVANUS P. THOMPSON, D.Sc. F.R.S., Prin. of the College
Mechanical Engineering and Mathematics .. E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry .. .. R. MELDOLA, F.R.S., F.I.C.

City and Guilds of London Institute,
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LECTURER ON ENGINEERING Harry Bamford, M.Sc.,
DRAWING AND DESIGN .. .. A.M.Inst.C.E.
LECTURER ON ELECTRICAL ENGINEERING .. .. John S. Nicholson, B.Sc., Whit.Sch. A.M.I.E.E.

The SESSION commences on October 17th, 1910, and ends on March 23rd, 1911. Students usuallly spend the summer months in practical work, thus receiving their training on the Sandwich system.

Prospectus of the Courses for the degrees of B.Sc. and D.Sc. in Engineering and Syllabus of Classes will be forwarded on application to the

ASSISTANT CLERK,
Matriculation Office,
The University, Glasgow.

UNIVERSITY OF DURHAM.

ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE.

PRINCIPAL: W. H. HADOW, M.A., D.Mus.

SESSION 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

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ENTRANCE DAY FOR NEW STUDENTS, TUESDAY, OCTOBER 4.

HEADS OF DEPARTMENTS.

Engineering .. Professor D. S. CAPPER, M.A., M.Inst.C.E. (Dean).
Professor H. M. WAYNFORTH, M.I.M.E., A.M.Inst.C.E. (Sub-Dean).
Professor M. CURRY, M.Inst.C.E.
Electrical Engineering Professor E. WILSON, M.I.E.E.
Mathematics .. Professor S. A. F. WHITE, M.A.
Chemistry .. Professor J. M. THOMSON, F.R.S.
Physics .. Professor C. E. BARKLA, D.Sc.
Metallurgy .. Professor A. K. HUNTINGTON, M.I.M.M.
Geology .. Mr. T. F. SIBLY, D.Sc.

For full information and prospectus apply to the DEAN or to the SECRETARY, King's College, Strand.

JOURNAL OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

Edited by P. F. Rowell, Secretary.

Part 202. Price 5/-

"LOSSES OFF TRANSMISSION LINES DUE TO BRUSH DISCHARGE, WITH SPECIAL REFERENCE TO DIRECT CURRENT" (*With discussion*). By E. A. Watson, M.Sc.
"MODERN ELECTRIC TIME SERVICE" (*With discussion*). By F. Hope-Jones.
"BALANCES FOR THREE-WIRE SYSTEMS" (*With discussion*). By A. G. Cooper.
"NOTES ON STANDARDISATION OF ELECTRICAL MACHINES" (*With discussion*). By R. Orsettich.
"THE PHYSICAL PROPERTIES OF SWITCH AND TRANSFORMER OILS" (*With discussion*). By W. P. Digby and D. B. Mellis.
"RATING AND TESTING OF MOTORS FOR INTERMITTENT WORKING" (*With discussion*). By Dr. R. Pohl.
"GRAPHICAL TREATMENT OF THE ZIG ZAG AND SLOT LEAKAGE IN INDUCTION MOTORS." By R. E. Hellmund.
"THE ARRANGEMENT OF EXPERIMENTAL ELECTRICAL CIRCUITS FOR LABORATORIES." By W. P. Steinthal, M.Sc.

Messrs. E. & F. N. SPON, Ltd., 57, Haymarket, S.W.

VICTORIA TURBO PUMPS.

Messrs. Willans & Robinson, Ltd., have now made arrangements for dealing with enquiries for their turbine pumps, and all enquiries should in future be addressed direct to their Victoria Works, Rugby. It is of interest to note that although the Victoria pump has only recently been placed on the market, already some 20 pumps have been built, ranging in size from 9,400 gallons of water per minute down to 150 gallons per minute. The pumps already built are designed for dealing with effective heads, from 35 ft. in some sizes, up to 535 ft. in others.

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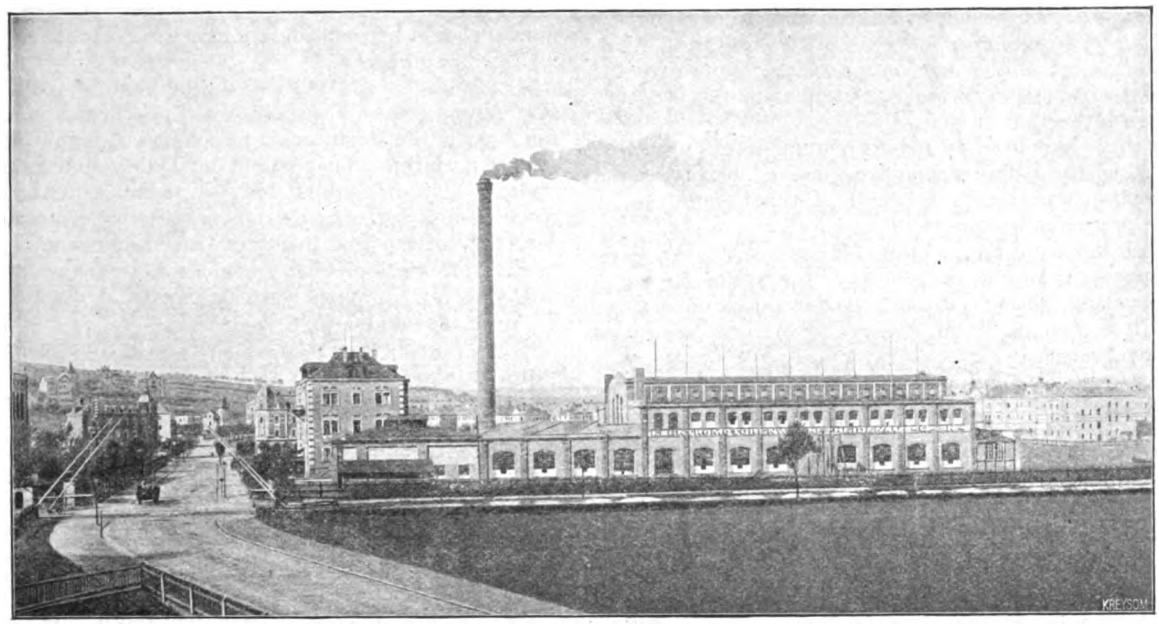

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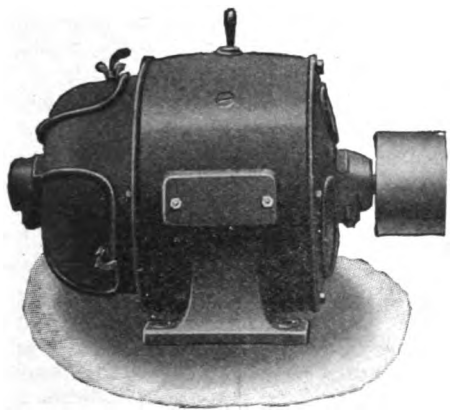
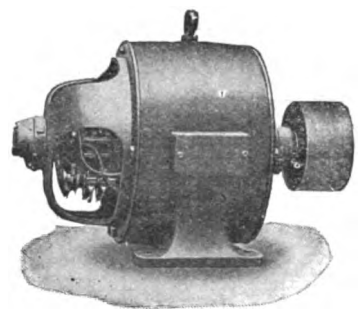
Heidenau 15 Bez., DRESDEN.





The former pattern is made in two types—the first for use in conjunction with testing transformers, and the second for connecting direct to a supply up to a maximum of 150 volts, for use with series resistances. The latter pattern is also made in two types—the first for pressures up to 120 volts, whilst the second is a special pattern for testing watthour meters. The section dealing with transformers is divided into current transformers and pressure transformers. The errors of phase displacement are only about 15 and 10 minutes respectively, and the accuracy is practically unaffected by wave form. Certificates of tests are included for both wattmeters and transformers, showing their efficiency and accuracy.

Electro-Medical Appliances.

We have received the following thoroughly instructive and lavishly illustrated booklets from Messrs. Siemens Bros. & Company, Ltd., Caxton-house, Westminster, S.W.: Pamphlet No. A506, "Electro-Medical Apparatus." This pamphlet has been produced for the forthcoming British Medical Association Annual Exhibition, London. It contains up-to-date illustrated abstracts of many of the Siemens electro-medical apparatus. As these, however, cover such a wide field, Messrs. Siemens Bros. have been forced to make the descriptions as short as possible, but they will be pleased to give more detailed information of any apparatus that readers may be interested in. Supplement No. 8 to Catalogue No. 506, "X-Ray Tubes and Accessories." This supplement has been issued owing to the enormous progress and improvements made in connection with X-ray tubes and accessories. Messrs. Siemens Bros. draw special attention to the section dealing with tubes for instantaneous radiography on pages 9 to 14 inclusive, as well as to the tubes for radio-therapy on the succeeding two pages. In addition, users will find the descriptions, on pages 22 to 24, of various forms of regenerators and regulators of interest. Messrs. Siemens Bros. will always be pleased to advise their clients with regard to the best form of tube which should be used for each particular purpose. Catalogue No. 525, "Radium Salts and Applicators. Radio-active Earths." This publication gives, for the first time, a practical description and prices of the various radium salts and applicators supplied by the Banque du Radium, Paris, for whom Messrs. Siemens Bros. are the sole agents in this country. The last section of the book describes the radio-active (actiniferous) earths and materials, based on the latest researches.

Coal Cutters.

Messrs. A. Hirst & Son, Ltd., sole makers of the Crescent coal cutters and coal drills, have now settled down in their newly erected works in Meadow-lane, Dewsbury. The premises are very commodious, and are constructed to allow of considerable expansion when necessary. The change had to be made on account of the quick demand for Messrs. Hirst's specialities. The Crescent coal cutter has proved itself a great success, and the firm has at present numerous orders for these labour, time and money-saving machines. A number of up-to-date machine tools have, and are, being installed in the shops and the number of hands considerably increased, and Messrs. Hirst hope, by careful management and efficient workmanship, to secure greater success, and to continue to send out their specialities second-to-none and better than most of their kind.

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ASSOCIATION OF CONSULTING ENGINEERS.

A meeting has been held at Caxton Hall to consider the desirability of forming an Association of Consulting Engineers, the object of the Association being to improve the status of the profession and to place it on a more satisfactory basis than hitherto.

Invitations had been issued to a number of consulting engineers, at the instance of a Provisional Committee, and the invitation was signed on behalf of this Committee by the following members :—

Representing Civil Engineering : Messrs. W. T. Douglass, E. L. Mansergh, Midgley Taylor and Henry Rofe.

Representing Electrical and Mechanical Engineering : Messrs. B. M. Jenkin, W. M. Mordey, Llewellyn Preece and James Swinburne.

Representing Gas Engineers : Messrs. C. G. Hunt and E. H. Stevenson.

Mr. A. H. Dykes, as hon. secretary of the Provisional Committee, read letters of regret at their inability to attend the meeting from Messrs. Charles Bright, E. M. Lacey, C. Hunt, H. Humphreys, W. H. Patchell, C. P. Sparks, W. T. Douglass, H. Rofe and J. F. C. Snell, all of whom expressed themselves as being heartily in sympathy with the objects of the meeting.

Mr. Midgley Taylor, who presided at the opening of the meeting pending the arrival of Sir William Preece, who was detained, said that the object of calling the meeting was to form an Association of Consulting Engineers. The subject had been before several consulting engineers for the past two years, or more, and as some initial step had to be taken, the members who originally took the subject up formed themselves into a Provisional Committee and had held a large number of meetings, with the result that the present meeting had been called to confirm, or otherwise, the action taken by the committee in the past. The object of the meeting was to see whether the general idea of the formation of the Association met with the approval of consulting engineers in this country.

Mr. James Swinburne formally proposed that the Association be formed at once. The self-appointed committee had met with many difficulties. First, there was an idea that there was some antagonism between the proposed Association of Consulting Engineers and the Institution of Civil Engineers and other institutions. The only thing that a body like the Civil Engineers could do was to frame rules of etiquette which were very good things in themselves, but which really limited the powers of the genuine consulting engineer rather than helped him. It was, therefore, necessary that consulting engineers should work in sympathy with the Institution of Civil Engineers and other institutions, and that they should, in addition, form an association themselves, not for the purpose of technical papers but purely to guard the interests of consulting engineers as such, and of the public in so far as the latter were bound up with the interests of the consulting engineer. All they could do was to say whether they were going to have an Association of Consulting Engineers or not. If they were, then they had to appoint something—a temporary committee or something of that sort—to which the details of formation and rules of the Association could be handed over for consideration to be finally approved by the members of the Association. In the case of this first meeting it was obviously impossible to make the list of invitations as complete as the committee would desire. It was hoped that any who had not yet been communicated with, would understand that the Association was intended to cover the broadest possible field consistent with its objects, and that those corporate members of the Institution of Civil Engineers who were practising purely as consulting engineers, would, by sending in their names, assist the Secretary in compiling his list of membership for submission to the committee.

The motion having been seconded by Mr. E. L. Mansergh, a general discussion took place.

Mr. E. H. Stevenson remarked that he only wished such an Association had been started 20 or 30 years ago, and although it might not now affect the older members like himself, it would be of very great assistance to the younger consulting engineers.

Mr. Robert Hammond dwelt upon the importance of such an Association from the public point of view. Although a private company was quite at liberty to have work carried out in any way that might seem desirable, in the case of municipal work it became highly desirable that public money should be spent only under the guidance of properly qualified engineers.

Mr. A. P. I. Cotterell asked whether the Institution of Civil Engineers were in favour of the scheme, as otherwise the Association might come in conflict with the Institution sooner or later, which would be highly undesirable. In reply to this question Mr. A. H. Dykes said that he had received a letter of a most sympathetic nature from the Secretary of the Institution of Civil Engineers.

The formation of the Association was also supported briefly by Mr. Campbell Swinton, Mr. B. M. Jenkin and Mr. H. W. Hancock.

Sir William Preece, who had arrived during the discussion and had taken the chair, said he was entirely in sympathy with the movement. He assured them of the sympathy of the Institution of Civil Engineers, and he was sure that the committee of the Association would be received heartily by the Council in the discussion of any points that might arise. What they wanted was to band themselves together as brothers in a similar profession with a very strong committee and strong chairman. He then put the resolution, that the Association be formed, to the meeting, and declared it to be carried unanimously.

The Chairman then read the list of names of the suggested committee, the names being as follows :—

As representing Civil Engineering : Messrs. Baldwin Latham, S. R. Lowcock, E. L. Mansergh, Henry Rofe and Midgley Taylor.

Electrical and Mechanical Engineering : Messrs. Robert Hammond, B. M. Jenkin, W. M. Mordey, W. H. Patchell, Sir Wm. Preece, J. F. C. Snell, James Swinburne.

Gas Engineering : Messrs. C. Hunt, E. H. Stevenson and Henry Woodall.

No further names being forthcoming, the committee were elected as above, with power to add to their number, to take what steps they considered desirable for the formation of the Association, and to formulate rules to be submitted to a general meeting to be called in the autumn.

Mr. B. M. Jenkin explained the lines on which a code of rules had been drawn up by the Provisional Committee, and placed them formally at the disposal of the new committee. The committee drew up a set of rules which they handed to the Institution of Civil Engineers for consideration. There was a proposal at that time that the Institution might distinguish in their list of members between those acting as consultants and others, but the Council were not prepared to do so. The object of the rules was to define what a consulting engineer was, and one of the objects of the Association was to make all consultants join together and work together along definite professional lines. That was extremely difficult, as one could only define a consulting engineer by saying what he could or could not do, but it was hoped that the rules would define pretty clearly what he might or might not do, and would be a help to young consultants as to what their professional conduct should be, and teach the public what a consulting engineer is. The idea was to print the rules with a list of members, so that anyone who wished to obtain a consulting engineer could consult the register. The rules were not complete, or in their final form, but were issued primarily with a view to discussion later.

Mr. James Swinburne proposed the election of Mr. A. H. Dykes, of 1, Victoria-street, Westminster, as honorary secretary, reminding the meeting that the success of the matter was entirely due to him, and this was seconded and carried unanimously.

Mr. Dykes responded briefly in accepting the position, and the meeting terminated with a vote of thanks to Sir Wm. Preece for presiding.

GALITZIN SEISMOGRAPH.—Prince Galitzin, of the Imperial Academy, St. Petersburg, and a Doctor of Science of the University of Manchester, was over at the British Magnetic Observatory, Eskdalemuir, Dumfriesshire, with Dr. Milne, to bring over and erect one of his seismographs, a gift to the observatory by Dr. Schuster, Emeritus Professor of Physics, Manchester University. The observatory already possesses one of Dr. Milne's seismographs.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Following my notes of last week, it may be interesting to remark that a question has been asked in Parliament concerning the Stephenson Dock, to which the reference was made. It appears that when a vessel of the Dreadnought type is full of stores and fully coaled this dock would not be available, but that it would be under conditions easily reproduceable, namely, when laden with the amount of coal and stores carried on trials. Whether this is completely satisfactory, having regard to the fact that a vessel needing repair might be considerably down by the head or stern, is perhaps a matter for debate.

An Electrically Lighted Garage.

Newcastle-upon-Tyne is nothing if not up-to-date, and the recently-opened garage in Northumberland-road, for the business purposes of Messrs. Rossleigh, Ltd., is probably one of the largest and best-equipped in the North. It covers an area of nearly 1,780 square yards, and has a showroom, with manager's and clerks' rooms attached, at the back of which is the garage proper, which is large enough, it is said, to accommodate trial runs, and has space for 100 cars. There are 15 private boxes. The whole of the lighting, which is by metal filament lamps in single drop pendants, was installed by Mr. Ernest Leng, electrical engineer, of Leazes-park-road, Newcastle. In the showroom and garage 100-c.p. lamps are used, while in the workshops, private boxes, etc., 50-c.p. lamps are installed. The whole effect is most brilliant.

Newcastle Foremen Engineers.

One of the local engineering societies which is doing very valuable work in this area is the Newcastle and District Association of Foremen Engineers and Draughtsmen. It includes practical engineers of all responsible grades connected both with mechanical and electrical engineering, and has been very successful in arranging instructive lectures, papers and visits. One of the last-named events took place last Saturday, when about 150 members went over the works of Messrs. Richardson, Westgarth and Company, Ltd., at Hartlepool. Of especial interest to electrical engineers was the turbine department, which is constructed on modern lines to build steam turbines not only of the Parsons type, but also the Curtis. The marine engineering departments were also found worthy of considerable attention by the visitors.

The South Shields Municipal Undertaking.

Electricity at South Shields has, according to the report of Mr. Cawthra, which has just been published, suffered during the past year, largely through the decreased receipts on the tramway systems, but also because of the introduction of the metal filament lamp. It is to be hoped that during the coming year these disabilities will be removed.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The accounts of the Birmingham Electric Supply for the past quarter have not yet been made up as regards consumption, but there is reason to believe that both for the quarter and for the half-year a substantial increase will be shown, particularly in power supplies. More definite information, however, is available with regard to the number of new connections made, and there are some points of special significance in the details. The increase latterly in power supplies has been largely for small motors. Birmingham has a great variety of manufactures, carried out in comparatively small establishments, and it has long been considered that the advantages which electrical power from a public supply gives to small and occasional users must ultimately be recognised to the mutual benefit of the electrical undertaking and of the industries of the city. This evidently is now coming about in a steadily increasing degree. The fact also is believed to have a gratifying significance in another way. A large number of manufacturers—and this is not confined to the small ones—have for a long time past been considering the question of adopting electricity, and have gone so far as to say that they were only waiting till better times arrived to make the change. It is from this very class that the new consumers are now coming in. Therefore, the fact may be taken as evidence that the better times have actually begun to arrive.

Increased Numbers.

In the six months, commencing January 1, the Department has joined up 221 consumers, including 2,500 h.p. in motors, and the equivalent of 4,870 60-watt lamps for light, or a total new consumption equivalent to 40,240 60-watt lamps. It may be interesting to note that the net increase in motors connected during the twelve months, recorded in the last annual report—though it should be borne in mind that that report covers three months of the present calendar year—was 5,720 h.p., so that if the present rate of increase should be maintained, the next annual report should show an increase something like double of that of the previous twelve months.

Greater Birmingham Bill.

All persons concerned with electrical matters in Birmingham and the neighbouring districts are anxiously awaiting the fate of the Greater Birmingham Bill now before Parliament. From the point of view of electric supply, as affecting the interests both of Birmingham and of the outside authorities, it is highly desirable that the decision of Parliament should be known as soon as possible. There are two important districts, namely, Yardley and King's Norton, in which manufactories of large size have sprung up during the last few years, and for these there has been during a long time past a call for electric power. Some of these factories are connected with concerns having works in the city in which electricity has already been adopted. In some cases an extension of the Birmingham powers to these districts would result in an almost immediate connection with the Birmingham mains, but there are one or two important cases in which the neglect of the present local authorities to provide supplies has caused a large installation of gas engines. Consequently, the prospect of custom in these cases which was held out a year or two back has been thrown somewhat farther into the future than would have been the case if the local authorities had risen to the occasion, or if Birmingham had had the opportunity of complying with the expressed desires of the proprietors of these establishments.

Aston's Position.

The settlement arrived at between Birmingham and the Aston Council, resulting in the withdrawal of Aston's opposition to annexation, includes certain concessions with regard to electricity charges. At the Local Government Inquiry held just before and after Christmas, Birmingham gave an undertaking that in the event of annexation, consumers in Aston and Erdington should not be subjected to charges in excess of those then in force. Since then further reductions have been made in Aston and Erdington (the two districts supplied by the Aston undertaking) and

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the final settlement arrived at last week includes an agreement to adopt the reductions sanctioned by the Aston Council on April 1 last, and to continue the present arrangements in Aston and Erdington for free meters and free service. The Birmingham charges range from 4d. to 2d. per unit for lighting, and from 13·5d to ·7d. for power. The Aston scale is in some cases higher and in some lower than that of Birmingham, but is more favourable to small consumers, while in Birmingham there is no exemption from meter rent. It is anticipated that the Aston generating plant will be continued in operation at least for some time after annexation, though ultimately no doubt the present arrangements will be subordinated to a more centralised and comprehensive scheme,

The Electricity Department's Secretary.

The selection made by the Birmingham Electric Supply Committee of a candidate for appointment to the newly created post of Secretary to the Department has been received very favourably by the electrical engineering community in the city. Although the position will be largely one of an administrative character, it is regarded as more satisfactory that the holder of it is to be a gentleman of eminent technical qualifications. The appointment has yet to be confirmed by the Council, but it is taken for granted that the Committee's selection of Mr. Howard Foulds will be approved. Mr. Foulds was appointed out of 320 candidates, and his selection by the Committee was unanimous. He is 40 years of age, and at present holds the position of Secretary and Manager to the Faraday House Electrical Standardising, Testing and Training Institution, London. He has held this position for the past 16 years. He is a Fellow of the Chartered Institute of Secretaries and an Associate of the Institution of Electrical Engineers. He is also a member of the Holborn Borough Council and a Poor Law Guardian. The Principal of the Faraday House Institution is appointed by the Board of Trade an Electric Inspector in connection with several of the electric supply undertakings in the neighbourhood of London, and the whole of the clerical work and the drafting of all reports on such matters has devolved upon Mr. Foulds.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

Perhaps the most important event which has occurred in the district, during the past week, is the agreement arrived at between the Spinners' Association and the Operatives' Unions in the matter of wages. No change on present rates is to be considered for five years, and it has been decided that instead of the customary one year's notice to reduce the rates, as provided for by the Brooklands agreement, this time is now to be increased to two years. Thus—as far as labour questions are concerned—the Lancashire cotton trade is secure for about seven years, and it only remains for the present shortage of cotton to be made up by good crops in the future to give the trade a lease of prosperity greater than it has ever had before.

Middleton Tramways Contract.

On Friday last, at the Manchester Assizes, Justice Hamilton decided a case of some considerable interest to contractors. The plaintiffs were Messrs. G. Freeman & Sons, Hollinwood, and they claimed £1,700 from the Middleton Electric Traction Company, Ltd., for some extra work done in connection with the construction of the tram line from Rochdale to Middleton. Freeman & Sons were awarded this contract in 1901 for £38,760, and at that time it was agreed that payment was to be made for certain extra work which was not contemplated in the contract agreement. The Middleton Company being a subsidiary of the British Electric Traction Company, Mr. Sellon, the engineer to the latter company, was generally responsible for the supervision of the work, and he duly certified it. Mr. Angus (one of Mr. Sellon's assistants) was the resident engineer on the Middleton contract, and he gave orders for extra work amounting to over £6,800. It was in respect to these orders that the claim was made. The defendants stated that Mr. Angus was not authorised to give the orders within the meaning of the contract, and they also contended that some of the work for which payment was claimed was work included in the original contract. The case took three days in the hearing, and Mr. Justice Hamilton eventually found for the defendants, with costs. He did not, however, think that the plaintiffs had been very well treated in the matter, but they had no redress.

A Correction.

In the description of recent developments at Bury, given in last week's notes, a rather awkward printer's error (probably accounted for to some extent by bad writing in the "copy") crept in. "Zollhy type turbines by Busgranes," should, of course, be "Zoelly type turbines by Musgraves," the famous Bolton firm. It will be remembered that this firm showed at the 1908 Manchester Electrical Exhibition a 600 kw. turbine direct coupled to a Siemens three-phase alternator. This, with a duplicate set, are now at work at the Falcon Mills, Bolton, a mill of 100,000 spindles, spinning superfine yarns. These two turbines were the first of the type to be built in England.

Developments at Bolton.

In common with several other Lancashire towns, Bolton is now faced with the necessity of providing further plant to meet the growing demand. The present buildings are quite full, and it is rarely one sees a station so closely "packed" with machinery—for there is only a narrow gangway between the units and the walls. As the present site does not allow of extensions, and is, besides, rather unsuitably situated, a new site has been bought at "Back o' th' Bank," about a mile from the existing (Spa-road) station. Here there will be ample room for all the extensions likely to be required for years to come. The land is situated between the canal and the railway line. Mr. A. A. Day, the borough electrical engineer and tramways manager, is now going into the scheme for the new buildings and plant, but it will be some little time before this will be ready for submitting to the Local Government Board enquiry to obtain the necessary borrowing powers. The new station will, however, be three-phase, at about 6,500 volts, 50 cycles, this having already been adopted in the later extensions at Spa-road. The latest addition to the system is the Duncan-street sub-station, where the three-phase 6,500 current is converted into direct current for the local load. Until this sub-station was put down, the district was served by two low-tension cables supplying direct current from Spa-road. Owing, however, to the rapid growth of the load, these cables became overloaded, and in order to get the required voltage at the outlying areas, the pressure had to be put up abnormally at the station, with the result that in the centre of the town, near Spa-road, regulation was very bad, and the lighting of the shops was being seriously upset. On going into the question of laying new mains, it was found that to supply the 2,600 kw. (which is the present plant capacity of the sub-station), allowing only a moderate regulation, the cost of direct-current cables alone would have been £18,000, without switchgear or other apparatus, and this for a 460 volt distribution. As a very large consumer was willing to go on the mains and scrap their own generating plant if a supply was given at 115 and 230 volts, this load would even then have necessitated a sub-station with running machinery. The £18,000 mentioned is based on copper at £58 per ton, but three years ago, when the scheme was being considered, copper was about £100, and it has, of course, dropped to £58–£60 since, so that if the direct-current mains had been extended then they would have cost £31,000, and £13,000 would have already been their loss in value. The sub-station with three-phase high tension transmission, equipped with two 600 kw. rotary converters, 6,500 volts three-phase to 460 volts direct current, one 800 kw. rotary three-phase to 230, and one 600 kw. rotary three-phase to 230, allowing room for a further 1,600 kw. of plant, and complete with all switchgear and the high tension cables from Spa-road has only cost £14,150, or very little more than the depreciation due to the drop in the price of copper since the time the station was first planned. It is interesting to note that this has all been paid out of revenue. Two travelling cranes, one of 10 tons and the other of 7½ tons, are included in

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the price. The question of the most suitable converting plant to install was one which caused Mr. Day some difficulty in settling, but after a careful consideration of the merits of the motor generator, the rotary converter and the motor converter types as then known, he decided to install rotaries (British Westinghouse make), and their performance has fully justified the confidence he put in them. In consequence, the station has been visited by many English and Continental central station engineers when considering the question of rotary sub-station machinery and the general design at low capital cost of such sub-stations. Dobson and Barlow, the great firm of textile machinery engineers, are the customers for the 230 volts supply from this station, and it was for their benefit that the 600 and the 800 rotaries were put in. It is interesting to note that the connections at the sub-station have been so made that it is possible to run these two 230-volt machines, one on each side of the 460-volt three-wire supply, in conjunction with the other 460-volt sets. This Duncan-street sub-station stands on the straight line between the Spa-road and the new site, and it is intended to run the high tension mains from both stations to it, so that they may be used in conjunction with one another.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Complaints are being made that long distance stations are being built without due regard to economy, with the result the Chambers of Commerce are taking up the matter and formulating plans for the future which will no doubt remove this reproach. They propose to take over the erection of such stations themselves, or at least to secure that they shall be erected and managed under the control of specially instituted departments of the Chambers. Particular stress is laid on the greatest possible cheapness of construction consistent with efficiency, on the provision of means for future extension of the station should need arise, on economy in working expenses and, finally, on supplying current at the lowest possible price. This last point is evidently the vital one, the others being the conditions indispensable for its attainment.

Preserving Telegraph Poles.

The method proposed by the French physician Boucherie, viz., to dip the lower end of the trunk in the preservative solution so that it rises up and displaces the sap has been objected to by German engineers on the ground that it only answers with freshly felled trees cut down at the right time of year, and having undamaged bark, and besides that far more preservative is necessary than when the usual method of forcing the preservative into the wood at high pressure is adopted. Where, however, pressure plant is unavailable, it answers fairly well, and certainly increases the longevity of the pole very considerably, although not so much, of course, as the pressure or impregnation method of preservative liquids. Copper sulphate is that most generally used, but its action is weak and large quantities of it are wanted—three times as much as can be sucked up in the Boucherie process. Nearly the same can be said of zinc chloride, but nevertheless that salt is both cheaper and stronger. Bichloride of mercury is expensive, but very effective. Creosote oils are largely used, but are inapplicable except to coniferous trees. Fluorides, especially zinc fluoride and sodium fluoride have been used in Austria with good results. Either has five or six times the power of copper sulphate.

Protection Against Over Tension.

F. Schrottke has an article on this subject in the "Elektrotechnische Zeitschrift." After some brief allusions to the peculiarities of oil resistances and horn lightning conductors and electric valves, he arrives at the conclusion, after considering many oscillograms that the lightning conductors constitute a reliable safeguard against excesses of voltage, but that electric valves do not do so.

Electric Cast Iron.

The following figures are given by Professor Neumann as the details of the cost of production of one ton of cast iron in the electric furnace at Domnarfvet. It should be mentioned that a furnace of 2,500 h.p. with all fittings complete costs about £3,000. The costs of production are then :—

	Marks.
Crude iron at 11·25 marks per ton	19·12
Current 0·36 a year h.p.	14·60
Coke at 23·6 marks per ton	7·80
Limestone at 6·80 per ton	0·68
Attendance	3·28
Maintenance	6·75
Sundries	1·47
	53·70

The finished iron fetches 63·5 marks per ton, so that the profit is nearly 10 marks. Some of these prices are astonishing. For instance, coke at over 20s. a ton and cast iron at £3 3s.

Company Notices.

The Accumulatoren Fabrik Aktiengesellschaft of Berlin made a net profit of 1,549,382 marks in 1909, as against 1,476,444 marks in 1908. A 10½% dividend is again payable, absorbing exactly a million marks. The carry over is 72,206 marks.

The G. Lorenz Aktiengesellschaft of Berlin made a net profit of 263,776 marks in 1909. The dividend is 16% as in 1908 on 1,400,000 marks capital.

The Elektrizitatsgesellschaft vorm. W. Lahmeyer & Company, of Frankfurt, made a net profit for 1909 of 1,454,472 marks (1,506,210). The dividend falls from 6% to 5% on the capital of 25 million marks. The carry over is 67,392, as against 72,268 marks.

In co-operation with their usual banks the Bergmann Elektrizitatswerke have founded a new company to be styled the Bergmann Elektrizitats Unternehmungen Aktiengesellschaft, with a capital of 12 million marks. The object is the construction and working of power stations and electric railways. The departments of the original Bergmann company dealing with such matters will be transferred to the new concern.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The New York "Electrical World" begins in its issue of June 30, a series of articles giving an account of the organisation and work of the leading national electrical engineering bodies of the world. The first article of the series deals with the British Institute of Electrical Engineers which forms also the subject of some complimentary editorial observations.

"It is appropriate," says the writer, "that the Institution of Electrical Engineers of Great Britain should form the subject of the first article, as it ante-dates all others in organisation, and has perhaps of all electrical societies most consistently maintained the character of a purely professional body. Naturally the body has not maintained its professional character free of attack, and only recently has been subjected to strong influences from commercial and industrial sources which, if they should prevail, would greatly weaken this character. On the other hand, the Institution, in common with similar British professional bodies, has been the object of criticism on account of its non-professional and student grades of membership, and the organisation is advocated from time to time of a national professional body in which membership shall be eligible only to engineers of unquestioned standing and ability, and without reference to their field of work. The Institution has an enviable record of well-directed activity aside from the reading and discussion of papers, which doubtless is to be ascribed partly to its strong and stable government, and partly to the British repugnance to dilettantism, which term unfortunately applies to the work of many scientific and professional societies.

Differences of Administrations.

"The governmental organisation of the British and American national electrical engineering bodies differs," continues the "World's" article, "widely in many respects, and in several of these respects it would appear

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that this difference is greatly in favour of the British society. As conducted under its present system of government, the American Institute of Electrical Engineers is, in effect, a New York City institution, for its outlying branches have neither initiative nor voice in Institute affairs, and their status precludes any professional standing. As an illustration, it may be pointed out that while every paper presented at the New York meeting is printed in the 'Transactions,' last year only 5 of 334 original papers presented at local sections and branches enjoyed that distinction. The British body, on the other hand, provides for full membership in its Council of the chairmen of local sections, who are elected by local nomination and ballot, and no discrimination appears to be made in favour of papers presented at the London meeting as against papers presented at local sections; in fact, in some issues of the I. E. E. 'Transactions,' the papers and discussions from local sections largely predominate. In view especially of the commanding and time-honoured position of London as the intellectual and professional centre of the British Isles, the liberal treatment accorded to provincial groups of I. E. E. members is in striking contrast with the present A.I.E.E. oligarchical system. While the manner of providing for the presidential succession in the British Institution is, under British conditions, more likely to assure the honour of the highest office to unquestioned leaders in the electrical engineering profession than would any system of popular nomination, the method, if adopted here, would undoubtedly fail owing to the facility with which it could be manipulated to serve individual and commercial ends. To be entirely frank, the selection of the president of the A.I.E.E. has come to lie with one or more loyal friends of the prospective candidate, who, if they become active sufficiently early in the season, have merely to circulate a nominating paper for signatures which are rarely if ever refused, and in due course the official ballot of the Institute goes out with the name thus selected at the head."

Photometric Standards.

At the 27th annual Convention of the American Institute of Electrical Engineers at Jefferson, N.H., a paper on Carbon Filament Lamps as Photometric Standards, by Dr. Edward B. Rosa and Mr. G. W. Middlekauff, was read by the chairman, Mr. Robb. The paper was based on the experiments undertaken at the Bureau of Standards in Washington to determine the permanency of carbon-filament lamps as standards of light. The flame standards not being reliable for precision work in photometry, nor as convenient as primary standards ought to be, carbon filament lamps have for many years been used as convenient secondary working standards, and in recent years have been employed in making careful comparisons of the photometric standards of the United States, England, Germany and France. The experiments undertaken at the Bureau of Standards were with the object of finding the performance of the lamps during the seasoning process, and also during subsequent burning which would correspond to a long useful life of the lamps as standards. A double photometer equipped with potentiometers for the precise measurement of current and voltage was used in these tests. Automatic recording cylinders were used to take down the readings. The tests included determinations at constant voltage, constant current and constant watts, and from these it was found that the most reliable results were obtained when the lamp was run at constant watts. Most of the tests were made with a batch of 200 64-watt 16-c.p., 110-volt lamps that were mounted in 32-c.p. bulbs to reduce any possible effect of blackening. Careful record was kept of these lamps through the various stages of the seasoning process. The lamps gave very satisfactory results, and it was found that with a precision photometer and expert observers a mean error in the average candle-power of 6 lamps measured at one time was about 0·1%. In the case of 4 lamps burning 250 hours, the variation in candle-power was only a few hundredths of one candle-power. Messrs. Rosa and Middlekauff therefore conclude that with such a precision of measurement and such a satisfactory performance the unit of candle-power not only of a commercial laboratory but also of national standardising laboratories may be maintained for a long period of years by carbon-filament incandescent lamps much more constant than could possibly be done with any other form of primary standard as yet proposed.

The Electric Locomotive.

At the same meeting a noteworthy paper on the electric locomotive was presented by Mr. N. W. Storer and Mr. G. M. Eaton, both of the Westinghouse Company. The writers take the view (by no means held by Mr. George Westinghouse) that the electric locomotive is not so well suited for interchangeable service as is the steam locomotive because of the fact that its continuous tractive effort is practically constant regardless of the speed at which it is operated. A steam locomotive, on the other hand, can develop its maximum horse-power at almost any speed, and its continuous tractive effort may be anything from its maximum, which is developed at starting, down to that necessary to give its maximum horse-power at its maximum speed. It may be contended, the writers say, that where gearless motors are used it is simply a matter of winding the motor to develop a given tractive effort at its maximum speed, and it will then be suitable for any service requiring this tractive effort at lower speeds. This is true, but for mechanical reasons the converse is not true; namely, that a freight locomotive can be operated in passenger service by winding the motors for a higher speed. An economical mechanical design for a locomotive, which is thoroughly satisfactory for freight service, will not be at all suitable for the high-speed passenger service. Steam locomotives have been used interchangeably to some extend in railway service, but in general this has been found impracticable. In discussing transmission through gears, the authors remarked that gears can be obtained to perform satisfactorily in any class of railway service. They said that while it is too early in the use of gears for large locomotives to make an absolute statement of fact in regard to the allowable pressure, experience thus far indicates a pressure of 1,000 lb. per in. width of gear face as a perfectly practicable value for continous rating of large gear. With special steel pinions and high-grade gears it is probably safe to exceed this figure. It is well known that for short hauls pressures far above 1,000 lb. per in. are now in daily successful operation. In the locomotives for the St. Clair tunnel, for instance, the pressure is carried on a single gear having a 6-in. width of face. The normal loads at which the locomotive operates on the up-grade give a pressure of from 1,500 lb. to 2,000 lb. per in. width of face on the gears. With this pressure the pinions have a life of from 40,000 miles to 50,000 miles, and none of the gears has yet worn out, although the locomotives have been in continuous operation for over two years. With twin gears there is a possibility of further increase in unit pressure as the absence of relative skewing of pinion and gear shafts produces a better application of the tooth load. Transmission by side-rods possesses some very distinct advantages. It permits the use of a single powerful motor to drive two axles. The motor is mounted in the cab instead of under it, so that all parts are readily accessible and are thoroughly protected from dust, dirt and water from the roadbed. The location of the heavy motor so high in the cab raises the centre of gravity of the locomotive to a height corresponding to that of high-speed steam locomotives. The side-rods form a transmission system that is familiar to all steam-locomotive operators. It apparently has all the good points of the steam locomotive rods and is, in addition, susceptible to perfect mechanical balance and gives a uniform tractive effort. The side-rod type of locomotive is at a disadvantage when compared with the high-speed geared type, because of the fact that the mechanical parts of the locomotive and also the motor frames must necessarily be much heavier to withstand the reciprocating stresses imposed on them. They will also require much more careful work in assembling, and will, therefore, be more expensive. On the other hand, it would seem that after the side-rod locomotive is once completed the mechanical parts should be very cheap to maintain.

An Electric Shunting Engine.

The Hoboken Railroad, Warehouse and Steamship Company has had in operation since May, 1906, a 60-ton electric

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switching locomotive which, it is stated, has given remarkably continuous and economical performance under varying and severe load conditions. Since the electric locomotive was placed in operation four years ago there has not been replaced a single contact on the switch group or a contact on the master switches or reverser. On the control apparatus nothing other than two tips on the live switch has been replaced. The brushes that are in the motors at the present time have been operating 14 months, and the master mechanic believes they will operate at least six months longer without replacement. No trouble has been experienced with broken brushes. Except that there has been replaced one pinion which was broken when a lock washer dropped into the gears, no repairs on the motor have been necessary. The cost of inspection and cleaning has been practically nothing. Every Saturday morning the man operating the locomotive makes an inspection of the equipment. With compressed air he blows out the motor and the various parts of the control apparatus, and cleans any part that may need it with a piece of cloth. This work is not charged to maintenance, as the operator in doing it is simply filling in his time. No extra time is needed for maintenance or inspection. The locomotive has a running and a starting drawbar pull of 14,500 lbs. and 30,000 lbs. respectively, and has a normal speed of 12 miles an hour. It has four 100 h.p. slow speed motors; a hand operated unit switch control, and Westinghouse air brakes with a D-4 compressor. The electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; the mechanical parts the steel cab and the trucks were built by the Baldwin Locomotive Works. The Hoboken company stated that there never has been a time when the locomotive refused to work or would not do the work required of it. It averages 12 hours a day of switching service very nearly every day in the year.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

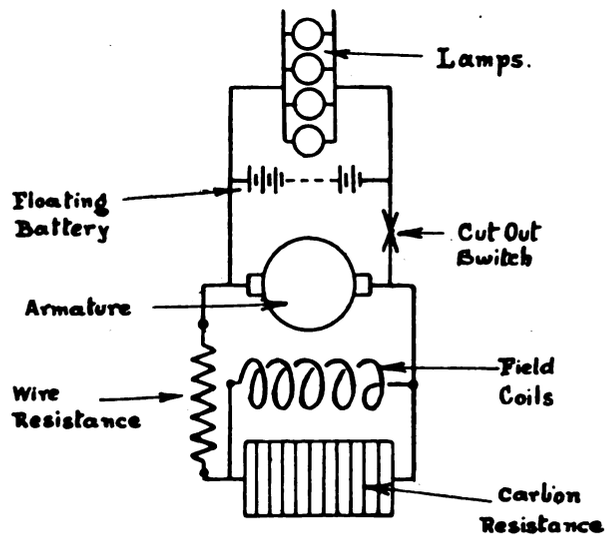
Question No. 1222.—Give curves and tables showing the variation in candle-power and resistance of carbon filament, and also, if possible, Osram and Tantalum filament lamps, with voltages varying from nought to normal. The examples may be either 110 or 220 volts, say, 16 candle-power.—" E. J."

Question No. 1223.—How far can underground cables replace overhead h.t. cables? What system is best for such underground cables, and what failures (due to internal and external causes) are most likely and most serious. Does earthing the system affect the problem? Give information on the cost and life of underground cables (actual data if possible). How are future developments of voltage, land value, population, etc., likely to affect underground transmissions?—" CITY."

ANSWER.

Question No. 1219.—Consider the possibility of lighting train carriages by acetylene gas and compare this system with lighting by electric glow lamps. Make the comparison with special reference to general convenience, safety, simplicity, economy, influence of weather, colour of light and general operation. How does the necessity to heat cars affect the problem? Information as to the costs of various systems together with notes on electric accumulators and on, say, one constant voltage generator (axle driven) would also be appreciated.

Answer to Question No. 1219 (*awarded* 10s.)—The old-fashioned candle and oil lamps are shown below to have possessed many of the desiderata of railway carriage illuminating sources, but their low candle power has rapidly led to their desuetude in favour of more powerful systems. Among the earliest improvements was Pintsch gas: this for over 40 years has given great satisfaction on many lines, and though acetylene is a more powerful illuminant it is usually more dangerous and costly than its older rival, besides being somewhat less convenient in practice. The use of electric railway carriage lamps has now resulted in a greater improvement upon gas practice than gas effected in comparison with oil lamps.



Some years ago the American passenger coaches were equipped with 150 c.p. each of gas lamps; the first electrically lighted coaches had 300 c.p. each, later cars on the same system had 700 c.p., and the latest dining-cars total 800-1,000 c.p. each.

GAS LIGHTING SYSTEMS.—Pintsch gas may be generated in bulk at some convenient station on the line and loaded under pressure to each car as it periodically visits this station, or the cars on outlying branches can be charged from the tanks of cars which will soon return to the central charging station. Acetylene gas (a more dangerous and powerful compound than Pintsch gas) may be generated on the cars as required, or may be carried compressed in cylinders. The advantages and disadvantages of each system hardly need explanation; in cases of generation *en route* each car should have its own complete gas plant so that a train can be made up of any cars, in any order, without derangement of the lighting system. Acetylene is a dangerous material to carry compressed in cylinders unless special precautions are taken. Acetylene forms with copper salts and with metallic copper at high temperatures an explosive compound—copper acetylide; under ordinary working conditions no risk is incurred from this cause, which should, nevertheless, be noted as a possible source of danger. When stored under pressure the gas decomposes into its elements (C and H) if strongly heated; the large resultant increase in volume makes the action practically an explosion; again, ignition at any one point of a cylinder of compressed acetylene would ordinarily spread to every part of the cylinder, causing, in fact, an explosion. To overcome these dangers the principle of the safety lamp is extended; a suitable cylinder is packed full of asbestos discs or of kieselguhr, infusorial earth or some artificial porous substance of similar nature; any of these have a porosity of some 80%. The " sponge " so obtained is saturated with acetone (B.P. 56° C.); this liquid has the property of absorbing at 15° C. some 25 × its own volume of acetylene per atmosphere, hence in 5 to 10 minutes an enormous volume of compressed acetylene can be absorbed in the prepared cylinder. The cylinder is provided with at least three fusible safety plugs. Suppose now that ignition occurs within such a cylinder, the acetylene is contained in a vast number of tiny acetone reservoirs connected by capillary passages through the absorbent material—passages so fine that no flame can possibly penetrate them; the flame therefore simply dies at the

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point of its origin. Should the cylinder be exposed to fire (in a railway smash or otherwise) the fusible plugs melt before a dangerous pressure is generated within the cylinder; the whole of the acetylene then escapes, burning in jets at the plug holes, but free from any explosion.

It has been found that whereas a 20" × 11¼" dia. cylinder holds 200 c.ft. Pintsch gas under a pressure of 10 atm., a similar cylinder containing asbestos and 40% its total volume of acetone, stores 2,000 c.ft. acetylene (= 100,000 c.p. hrs., or 50 days' supply for a car consuming 40 c.ft. per diem). A suitable central "generating" station for supplying 500 cars (American pattern) with acetylene occupies about 1,400 sq. ft.

There are several excellent "generators," enabling the safe manufacture of acetylene from carbide on the cars themselves whenever this course is desirable; 2½" to 3" lumps of carbide should be used, about ½ lb. water is required per lb. of carbide exhausted, and some 4½ to 5 c.ft. gas are obtainable per 1 lb. of carbide. (The theoretical figures are 1 lb. carbide plus 0·57 lb. water yields 1·16 lbs. slaked lime plus 5·85 c.ft. acetylene, at 30" pressure and 60° F.) The gas should be stored in a preliminary receiver at about 2 atm. pressure (any tendency to a further pressure rise should force back the water supply and stop generation). The gas, on passing through a throttle and filter bed, should be reduced to a pressure of 2½-3" water at the burners; meters placed in the main supply pipe from each "generator" will check the working of the latter and enable a determination of the amount of carbide unused at any time. 150 lbs. carbide is a suitable generator capacity, this supplying 600-700 c.ft. gas, feeding 20 ⅝-c.ft. burners for 50 hrs. (= 30,000 c.p. hrs.). With carbide at £13 per ton acetylene costs £1 10s. to £2 10s. per 1,000 c.ft., including labour and repairs; Pintsch gas costs about £1 per 1,000 c.ft., but is, bulk for bulk, less effective.

A careful comparison carried out a few years ago between Pintsch gas and acetylene gave these results:—

	Pintsch.	Acetylene.
	s. d.	s. d.
Cost per coach per hr.	0 3½	0 5¼
Average cdl. ft. illumination ..	1 0	0 7
Cost reduced to Pintsch illum.	0 3½	0 7½
Using latest mantles	0 2¾	—

Electric Lighting possesses the inherent advantage that no inflammable, explosive, or volatile matter forms the basis of the illumination. Three main systems are available:—

1. A turbo generator may be fitted on or next to the locomotive; this will draw steam from the latter when it is most wanted for tractive purposes. Further, such a small generating set is not efficient, its voltage regulation is bad, skilled attendance is required, the flexible steam pipe line is a source of trouble, and only specially-equipped cars and locomotives can be used together.

2. Storage batteries may be carried on each car, these cells being replaced or recharged at various stations on the system; the replacement of discharged cells *en masse* involves many spare cells. Re-charging, *in situ*, is, however, a very slow process (occupying practically as long as the discharge); gas cylinders can, of course, be very rapidly recharged—an important advantage.

3. An axle driven dynamo and "floating" battery may be employed on every carriage; about 20,000 carriages were thus equipped in England and America together in 1908. Power transmission is by belt. One ingenious method of securing constant voltage is shown in Fig. 1: the battery is alone used for speeds below 15 m.p.h.; at and above this speed the generator (shunt excited) and battery operate in parallel. As the speed rises, the current increases, other things being equal. This causes an electro-magnet armature to compress the discs of a carbon resistance, *shunting* the field coils as shown in Fig. 1. Very good regulation is thus secured, even at high speeds. The use of a *series* carbon resistance in the generator field gives poor voltage regulation at high speeds, and, moreover, any failure of the carbon resistance then disables the generator. To make the polarity of the supply independent of the direction of rotation, a reversing switch must be fitted in the field or commutator leads or the brushes must be rotated through one pole pitch. The latter may be automatically secured by mounting the brushes on a rocker having the desired angular freedom and moved to its limit in either direction by the drag of the commutator on the brushes. This involves heavy brush friction and losses, hence it is preferable to fit "latches" to the generator shaft, these operating knife switches and being later dragged out of rubbing contact with the latter by centrifugal force. An automatic switch cuts the generator "in" or "out" of circuit so as to avoid all danger of the small floating battery attempting to drive it as a motor; depreciation of the floating battery is usually heavy (see Table). By judiciously arranging a number of relatively small c.p. electric lamps maximum uniformity of illumination is secured. In the past the cost of electric lamp renewals has been variously quoted as from 4 to 7 or 8 times that of Pintsch mantles. This ratio must always be a matter of controversy, comparisons being so difficult and the conditions assumed being so varied; probably the ratio does not exceed 3 or 4 at the present day, while great compensations in other respects are obtained.

Costs.—The capital cost of electric lighting in trains varies from £175 to £360 per coach complete according to system employed, the total annual operating expenses averaging £100 to £150 per coach. Interesting data concerning these matters is given in the following Table, analysed from information published by O. W. Ott.

Item.	Annual Cost—£. Turbo-Dynamo on Loco.	Storage Cells.	Axle-Driven Dynamos.
Current	£29·0	£51·0	£25·6
Carriage of Lighting Equipment	7·6	12·6	16·4
Interest on ditto.	8·7	10·7	16·7
Depreciation { Generators ..	2·4	—	13·4
Depreciation { Batteries ..	8·4	19·7	26·2
Attendance (on train and in yard)	38·0	22·8	9·2
Lamp renewals	5·8	1·9*	5·8
Repairs	3·9	1·3	12·0
Oil, waste and miscellaneous	3·1	—	1·0
Total per Year	£106·9	£120·0	£126·3
Capital Cost Equipment per Coach	£175	£215	£335
Weight ditto ditto ..	2,075 lbs.	3,800 lbs.	4,900 lbs.

* Low figure due to steadier voltage.

—"Wren."

"SIMPLEX" IN LEEDS.

The Simplex Conduits, Ltd., have opened a branch office under the charge of Mr. W. Kay, late assistant at their Manchester branch, at 12, Gascoigne-street, Boar-lane, Leeds, where considerable stocks will be carried, in addition to conduits and fittings, of the company's other manufactures, such as lamps, cables, accessories, and so on. The new arrangement has been made with a view to accelerating delivery to the company's Yorkshire customers.

NEW ADDRESS.

Owing to the increase of business, necessitating larger premises, Messrs. Hogan & Wardrop have removed from Gloucester-mansions, Charing-cross-road, to 2, Gresham-buildings, Basinghall-street, E.C. The increased facilities will enable Messrs. Hogan & Wardrop to carry considerably larger stocks of their EMI fans and small motors, as well as a full range of the various switch gear manufactured by the Midland Electric Company. They also, as representatives of Cryselco, Ltd., will hold stocks of this well-known English incandescent electric lamp, both metallic and carbon filament. We are also pleased to learn that this firm has entered into a close connection with the Electrical Conduit & Fittings Company, of Walsall, and they will also carry extensive stocks of this company's manufactures at the new address. Their new telephone number is: London Wall 723.

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Business Notes and News.

LIGHTING AND GENERAL—Home.

AMBLE.—Mr. Frederick Swarbrick, of Leigh, Lancashire, has written to the Urban Council stating that he was interesting himself in the formation of a company to establish electric light and power undertakings in small towns, without Parliamentary powers, but merely on contract with the local authorities. The proposal is to use overhead wires wherever possible. The Council was asked to support the scheme by adopting electric lighting for street purposes. It was decided to ask for a quotation for lighting 95 lamps, and also that particulars of the whole scheme should be submitted.

BRADFORD.—Efforts are being made to induce the Corporation to extend electricity supply to Thornbury and other outlying districts.

CUCKFIELD.—The Hayward's Heath Electric Supply Company have given notice of their intention to apply for a Provisional Order to enable them to distribute electrical energy within their district.

DUBLIN.—The city librarians have been asked to meet and discuss the best way of lighting the libraries by electricity, and to suggest suitable fittings.

DUBLIN.—While the Local Government Board have sanctioned the raising of a loan for £3,000 by the South Dublin Union for purposes of installing electric light in the Workhouse, the Board of Works have declined to make the advance, on the score that the rates are already too high. It has been decided to advertise for tenders for the loan, which is to be repaid in 10 years.

GILLINGHAM.—The District Council are considering a proposal to abolish the premium system of pupilage at the electricity generating station, and to adopt in its place the appointment of apprentices by competitive examination.

GRIMSBY.—The Local Government Board have sanctioned the raising of a loan of £1,420 for public lighting by electricity, but, in view of the short time allowed for repayment, it was decided to pay the amount out of revenue.

KILDARE.—The Electric Lighting Committee are inviting applications for a collector, at a remuneration of 5%. Applications are to be received and examined on July 29.

LONDON: POPLAR.—The Borough Electricity Department had a revenue of £42,251 as against £37,810 last year, showing an increase of 11·76%, the previous increase having been 7·08%. The expenditure amounted to £21,835 (as against £19,467). After meeting all statutory obligations there was a net balance of £4,425, as against £3,381 last year. The cost per unit sold has been reduced by ·063d. on an increase of over two million units. The proportions of increase in actual output are: domestic supply 3%, power 24½%.

LONDON: STEPNEY.—For the year ending March 30, the Borough Electricity Department had a total revenue of £52,265 (£46,934 in 1909), and an expenditure of £31,449 (£28,748 in 1909). After paying interest and sinking fund charges, the net profit was £1,515, as against £1,808 last year. The total number of units sold amounted to 8,009,174, as against 6,833,865 last year. There was an increase of over 900,000 units sold for power and heating. It is satisfactory to find that the total costs have dropped from 1·505d. per unit to 1·445d. per unit.

LONDON: ST. MARYLEBONE.—The policy of popularising the Borough Electricity Department is answering exceedingly well. For the year ending March 30, the total revenue was £164,091 and to expenditure £42,051. After making provision for interest, sinking fund, etc., there was a net balance to carry forward of £8,481. The gross income from sale of current to private consumers advanced from £146,840 to £152,979, and this notwithstanding the adjustment of prices, which brought down the average yield from 4·13d. to 3·8d. per unit. For the current year the prices have been readjusted so as to give an estimated yield of only 3·475d. per unit. The total costs of production have been reduced from 1·19d. per unit to ·961d. The sales department cost £7,851 and brought in £6,666, a deficit of £1,185, but this covers expenses of the Publicity Branch. The accounts show that a fair profit was made on fixed cost of articles sold and work done.

LLANELLY.—A Board of Trade inquiry was held to hear objections raised by persons living within 200 yards of the site of the proposed generating station to be erected by the Llanelly and District Electric Light and Traction Company, Ltd. The difficulties were overcome, and the contractor, Mr. George Mercer, at once commenced work.

MALDEN AND COOMBE.—The Urban Council have retained Messrs. Handcock and Dykes to advise them in connection with the question of applying for electric lighting powers.

NEWPORT.—Both branches of the Corporation's electrical undertakings show net profits on the past year's trading: Lighting and power £375, tramways £2,321. But there is an accumulated deficit of £3,500, and the Local Government Board inspector now insists that this should be paid off before he reports favourably on the application for powers to raise £31,255 required for additional electrical plant. It is a difficult position, because the new machinery is urgently needed before the winter to meet growing demands.

PENMAENMAWR.—The District Council have decided to push forward the Promenade electric lighting scheme, to have it ready early in the season.

STRETFORD.—At a Local Government Board Inquiry into an application to borrow £2,150 for providing additional electrical plant, the Inspector said that last year seemed to have been a satisfactory one, as it had yielded a profit of nearly a farthing per unit. It was explained that the lighting of the main road by electricity had proved so economical and gratifying that there is a prospect eventually of extending the system into the side streets.

SWANSEA.—Mr. C. A. L. Prusmann's annual report of the Corporation electricity undertaking shows the same favourable features seen so generally all over the country. The revenue from private lighting was £13,051 (an increase of 9%), from public lighting £1,995 (increase of 4%), from power £2,762 (increase of 1%, a disappointing result), and from tramways £2,762 (9% increase). The total costs amounted to £12,283 (a fall of 7%), and there was a net profit of £2,722 (increase of 55%).

TAUNTON.—In spite of an increase of 24,000 units sold, and a reduction in cost of production by £23, the Electricity Committee had to draw £490 from reserve to meet loan repayment charges. This is largely due to a change of system in charging, which involved an expenditure of £240 on metres. It was resolved to advertise for an electrical engineer, at a commencing salary of £200 and half pupils' premiums, Mr. E. B. Thornhill being about to leave shortly.

TON, RHONDDA VALLEY.—The Ton Co-operative Society propose putting down an electric installation in order to provide light and power for their bakery and stores. It was desired to carry an overhead wire from the bakery in Bailey-street to their shop in Church-street, but the Rhondda District Council decline to sanction this. The Council have decided, in view of the numerous applications made in regard to private installations, to apply for an Electric Lighting Order.

WAKEFIELD.—From October next a number of streets are to be lighted by electricity, the Corporation electricity department undertaking the work.

LIGHTING AND GENERAL—Overseas.

BADEN.—A Supplementary Estimate has been laid before the Baden Diet for the preliminary works in connection with the establishment of a water-power station in the Murg Valley (Black Forest) above Forbach. The electrical energy generated will be used by the State Railway Administration for lighting purposes, for motive purposes at the railway stations and railway workshops, and also for the State harbour works at Mannheim. It is not proposed at present to utilise the power for working the railways. The total cost of the works, with the long-distance cables, is estimated at 26,784,000 marks (about £1,317,000), divided into two nearly equal sections, of which the first is to be taken in hand at once.

CALGARY.—A project is on foot to establish a large hydro-electric power plant near Calgary, to supply power for the city's enterprises and for industrial purposes. The City Council have fixed Edmonton's tax rate at 17 mills on the dollar, a half mill lower than the rate last year. Strathcona proposes to build a bridge across Mill creek to the east of the city at a cost of $38,000.

ROSARIO.—The Municipality has resolved to treat the question of the service of the United River Plate Telephone Company in an extraordinary session of the City Council. This is to be done with a view of improving the service. It is stated that the company has no concession, but only a permit to establish business, which was granted in 1886. It is now proposed to make the company pay the Corporation 5% of its gross receipts, and if the company refuses it is the intention to annul the permit and call for tenders for the service. We are inclined to believe that the intention to tax the company has been uppermost in the minds of the authorities, more so than improving the service.

SANTO FÈ.—Sr. Adolfo M. Torres has applied to the Government for a concession for a network of telephone lines throughout the province.

SANTA ROSALIA, MEXICO.—British capital has also been invested on the Conchos River, near Santa Rosalia, for the purpose of impounding the water of that river by a great dam,

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and intends to develop some 30,000 horse-power for the mining districts of Naica, Almoloya, Parral, Santa Barbara and the adjoining places. It has in view irrigation works sufficient for 200,000 acres of land in the Conchos Valley. The preliminary work is now under way.

SYDNEY.—Mr. R. H. Forbes Mackay, city electrical engineer, in his annual report shows that private lighting in 1909, as compared with 1908, was greater by 17% in load connected, and 20% in units sold, than the increase in 1908 over 1907. There was no considerable increase in the public lighting last year, but the increase in power and heating, as against 1908, was greater by 78% in load connected, and 20% in units sold, than the increase of 1908 over 1907. The disproportion between the increase in "loads connected" and in "units sold" was due to the unusually large number of lifts, cranes, etc., which were connected during the year. The increase in the number of arc lamps on hire in 1909 over the number in 1908 was greater than the increase in any previous year by 18%. The report points out that a rapid increase in this branch cannot in future be looked for, as the new metal filament lamp is displacing the arc lamp in many places. The engineer's report goes on to say: "The achievement of such results in the fifth completed year of working is unprecedented, so far as I know. I refer to the volume of business, the percentage 'gross revenue' bears to capital expended, and the lowness of working costs."

URUGUAY.—Over £53,000 is to be spent on the erection of post and telegraph buildings in the capital of the departments of Paysandu, Salto, Colonia, Sariano and Canelones.

TRACTION—Home.

BELFAST.—The City Council have adopted the tramway extension schemes. These involve: Donegall-road, cost £22,000; Shaftesbury-square and Ormeau-road Junction, £12,000; Stramnillis-road, £6,000; Ligoniel to Mill-avenue, £6,450; M'Art's Fort, £111,550; Castlereagh-road, £23,000; Bloomfield-avenue, £17,000; Old Lodge-road to Cliftonville-road, £25,000. A Bill will be presented in next Parliamentary Session to carry this into effect. It was also agreed that the Tramways and Electricity Committee should be requested to consider the desirability of constructing an extension from the Antrim-road tramway up the Cavehill-road as far as the bridge on the Old Cavehill-road.

CHESTERFIETD.—The municipal tramways had a total revenue of £11,858 during the last year, and the expenses were £7,401, to which have to be added sinking fund and interest £4,528, thus leaving a net balance of £25. The disquieting point is that the working expenses have risen from 5·93d. to 6·31d. per car mile, mostly due to the reduction of car miles run. However, during the five years of its existence the tramway undertaking has paid working expenses out of revenue, reduced the debt by £6,800 and placed £3,653 to revenue.

EDINBURGH.—At a Town Council meeting, a letter from Messrs. Connell & Campbell. S.S.C., on behalf of a London electric construction company, submitting proposals for new electric tramways in Edinburgh, was submitted. The scheme is a very ambitious one, taking in Easter-road, Canongate, High-street, George IV.-bridge, Fountain-bridge, and going on to the corner of Ardmillan-terrace. Another proposed route is by Liberton, Mayfield-road, Kilgraston-road, and Meadow-walk. The letter was sent for consideration to the Tramway Committee.

KINGSTON-ON-HULL.—The revenue from the Corporation tramways was £136,985, and the expenditure £86,098, and the net profit for the year £22,942. The motor omnibus service brought in a revenue of £1,333 and involved an expenditure of £3,391.

LONDON.—The County Council propose to seek authority in the Session of Parliament of 1911 to enable the Council: (1) to fix tramway stopping signs to lamp-posts, etc., along tramway routes; (2) to make a charge for packages (other than personal luggage which does not exceed 28 lbs. in weight and does not cause inconvenience to other passengers) taken by passengers on cars in operation on the Council's existing tramways hereafter constructed or acquired by the Council.

MAIDSTONE.—The annual report just out shows that the Corporation Tramways had an income of £2,329, while the expenditure amounted to £4,828.

PLYMOUTH.—The Corporation Tramway Committee are considering the advisability of adopting the trackless trolley system for certain suburban extensions, as feeders for the main tramway lines.

TRACTION—Overseas.

GROENLO, HOLLAND.—The communal authorities have granted a concession for the construction of a tramway from Borculo to Winterswijk, and thence to the German frontier. It appears, further, that the communal authorities of Nymegen have decided to take over, on behalf of the town, the working of the steam tramways at present owned by a private company, and to substitute electric for steam traction at an estimated cost of over £80,000.

MELBOURNE.—The Premier of Victoria and the Minister of Railways are anxious to introduce electric motor services on the railways for country districts, but the Railways Commissioner is opposed to the project. Efforts will be made to push forward the scheme, which, it is held, would enable a better and faster service to be inaugurated in country districts, with a reduction of expenses.

SEVASTAPOL.—A Belgian company, which constructed and controls the electric lighting and tramway in Sevastopol, has recently obtained a concession for the construction of an electric tramway, etc., at Simpheropol, the chief town of the Crimea.

TAIHOKU, FORMOSA.—Applications have been addressed to the Formosan Government by three rival groups of company promoters for a concession for the construction of electric street railways in the city of Taihoku, a place with a population of 84,000.

COMPANIES' MEETINGS AND REPORTS.

EDMUNDSON'S ELECTRICITY CORPORATION.

The ordinary general meeting was held at Winchester House. Mr. P. D. Tuckett, who presided, said that marked progress had been made in the past year. The net result was that, after providing for £1,449 additional debenture interest, they were able to carry to the balance sheet a profit balance of £10,768, against £597 a year ago. The general improvement was due to the inclement weather of the past year and to the lower price of coal, but these advantages had been somewhat offset by the temporarily adverse influence of the metallic lamp. Notice had been received from the Winchester Corporation of their intention to purchase the undertaking of the Winchester company. As to the position and prospects of their undertakings generally, there was every reason to anticipate steady improvement, although it would be unreasonable to expect that their rate of progress would be continuously maintained at the same level as during the past year. The report was adopted.

NATIONAL TELEPHONE.

The annual report states that the income accrued in respect of the business of the half-year amounts to £1,677,587 17s,. as compared with £1,549,136 2s. 9d. for the corresponding period of 1909, being an increase of £128,451 14s. 3d. The working expenses for the half-year amount to £974,757 7s. 3d., as compared with £890,798 2s. 5d. for the corresponding period of 1909, being an increase of £83,959 4s. 10d. The net result for the half-year (after deducting the Post Office Royalties amounting to £161,529 16s. 1d.) is a profit balance of £541,300 13s. 8d., as compared with £509,210 10s. 10d. for the corresponding period of 1909, being an increase of £32,090 2s. 10d. The rentals carried forward for unexpired terms of running contracts amount to £1,482,179 1s. 8d., as compared with £1,366,283 9s. at the corresponding period of 1909, being an increase of £115,895 12s. 8d. Out of the available balance of £409,093 14s. 1d., the Board will recommend the payment for the half-year of a dividend at the rate of 6% per annum on the first and second Preference shares, 5% per annum on the third Preference shares, 6% per annum on the preferred stock, and 6% per annum on the deferred stock, less income-tax in all cases. The Board also propose to transfer £175,000 to the reserve fund account, and to carry forward the balance of £15,343 14s. 1d. Capital expenditure.—The sum of £216,873 14s. has been expended on capital account during the half-year in the erection of 16,286 additional exchange and private stations, and in the construction of underground works.

COMPANIES REGISTERED.

EAST KENT ELECTRIC SUPPLY COMPANY (LTD.).—£30,000, in £5 shares (1,500 Pref.). 36–8, New-street, Ashford, Kent.

ELECTRO-METALS.—£30,000 (4,000 £5 Preference and 10,000 £1 Ordinary). Engineers, electricians, metallurgists, etc. Agreement with Jens Orten-Boving, D. Spencer, and P. R. Cobb (trading as Jens Orten-Boving & Company). Private.

OUDTSHOORN ELECTRIC LIGHT AND POWER COMPANY, LTD.—£15,000, in £5 shares. Business: To acquire from the General Electric Company, Ltd., the concession granted by the Municipal Council of Oudtshoorn, Cape Colony. Private company. Office, 71, Queen Victoria-street, E.C.

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PATENTS.

Apparatus for Electrically Heating Air.

5777.—1909. G. G. Bell & J. St. V. Pletts, Teddington. The apparatus consists of a mass of material capable of storing a large amount of heat. This is surrounded by a coating of heat insulating material. The mass is heated by electricity, continuously or during such portion of the day when the electricity can be purchased most cheaply. The heat is transferred from the mass to the air.

Electric Starting and Regulating Switches.

13590.—1909. G. O. Donovan, Birmingham. The switch contacts are mounted immediately upon the underface of the cover plate, whereby the safety of the operator is ensured without the necessity for a shield or protector. The leads for conveying the current may be connected to the switch without exposing the energised parts.

Electric Arc Lamps.

13842.—1909. W. R. Ridings, Stretford. In this magazine arc lamp both the carbons which act as the working electrodes are fed forward and simultaneously by a device attached to a carrier which is alternately raised and lowered by a single sprocket chain, so that the device is caused to engage successively with each pair of carbons in the magazine.

Electric Heating Device.

13961.—1909. British Thomson-Houston Company, Ltd., London, E.C. The heating device comprises a heating unit consisting of a flat tapered coil of bare conductor, the wider end of which is situated below the narrow end. The coil is enclosed in a basket at the side of a metal cage. The insulators supporting the coil are in the upper part of the cage.

Electric Stoves.

14040.—1909. K. Preiss, Charlottenburg. The electric lamps are provided with partly transparent and partly opaque chimneys which are caused to revolve. Logs of wood are placed in the stove, and the variations in light and shade thrown upon the logs through the revolutions of the chimneys, together with colour effects produced by reflectors, give the appearance of a real wood fire.

Protective Arrangements for Electrical Current Distribution Systems.

14352.—1909. W. C. H. M. Georgi, Newcastle-on-Tyne. For the purpose of cutting out a cable in electrical current distributions when a fault occurs between a live conductor of the cable and its covering, it has been proposed to conduct the leakage current to earth at the generator station by way of the cable covering, whereby the current in its passage to earth traverses an electro-magnetic device adapted to secure an opening of the switch controlling the cable. The object is to provide an arrangement specific to a three-phase alternating current system for use in mines. This arrangement comprises a set of busbars at the point of distribution; one or more phase alternating current generators are connected to these bars, with the neutral point of the system earthed at the generators. Feeder cables are connected to the busbars, and a switch is at the supply end of each feeder. An electro-magnetic device for the direct operation of the switch is included in a conductor leading from the cable covering to the point to which the generators are earthed.

Rotary Electric Converters.

17564.—1909. British Thomson-Houston Company, Ltd., London, E.C. The armature is provided with a commutator and collector rings. Motor current is delivered to, and generator current taken from the armature by electrical connections. One of the currents flows through the commutator and is less in amount than the other current. Unwound commutating poles are located at the points of commutation of the generated current flowing through the commutator, and magnetised by the resultant armature reaction.

Pendant Electric Light Fittings.

17711.—1909. S. K. Thompson, Westminster. The flexible conductors connecting the lamp and lamp-holder with the ceiling rose or other terminal connected with the supply leads are kept distinct and separate. This separation is assisted and preserved by the formation of the pulleys, under and over which the flexible conductors are passed.

Electrolytic Condensers Applicable as Lightning Arresters.

21480.—1909. British Thomson-Houston Company, London, E.C. This protective device for electric distribution systems comprises a number of electrolytic cells connected in series, a normally open high resistance shunt circuit around each of the cells, and means responsive to the temperature of each cell for automatically closing the circuit when the temperature of the cell exceeds a predetermined point, and for automatically opening the circuit when the temperature falls below that point.

Socket Plug for Electric Lamps.

22029.—1909. A. Denereaz, Montreux. The socket comprises a casing of dielectric material. A member, carrying springs, is arranged at the inner end of the casing and is connected to the conductors. The springs engage recesses in the wall of the casing, so that the member cannot be moved from the cover once it has been inserted.

Means for Supporting Overhead Wires and Cables for Railway Systems.

26444.—1909. S. W. Mitchell & H. M. Dudgeon, Aston Manor. The troughed parts of the ears or frogs for carrying the wire are provided with shaped tips of copper. Each tip is tapered to a fine point so as to enable a better union with the wire.

Electric Tumbler Switches.

26570.—1909. E. W. Denny, Kensington. The switch comprises an electro-magnet below the switch mechanism and a movable contact member. An external operating handle extends through the crown of the switch casing, and, although separate from the contact member, is adapted to engage therewith to take the movable contacts into engagement with the fixed contacts. A stationary catch device engages with the contact member for maintaining the switch in its on position. The armature is adapted to be attracted by the magnet in the event of an overload; when the armature is attracted the catch is disengaged and the switch opened.

Electric Arc Lamps.

26706.—1909. Költing & Mathiesen, A.G., Leutzsch. The object is to provide means whereby on any lamp being extinguished a compensating resistance shall be switched into the circuit so that the remaining lamps shall be unaffected.

Oscillating Discharge Circuits.

28452.—1909. E. von Lepel, Strand, W.C. This is an arrangement for producing rapid electric oscillations in which two oscillatory circuits closely coupled are connected in parallel with a discharge gap.

Wireless Electric Signalling.

29481.—1909. R. A. Fessenden, Brant Rock, U.S.A. In this apparatus for wireless signalling from or to a flying machine, two capacity areas are used, consisting of thin conducting planes so disposed as to offer substantially no resistance to the motion of the flying machine.

Metal Filament Lamps.

350.—1910. O. Krause, Berlin. This improved lamp, in which the filament carriers are supported elastically, has an elastic connection of the stem fixed axially in the lamp foot with the supporting device surrounding it by a single spiral spring placed inside the tubular filament supporting device, and by an elastic connection of the lower part of the filament supporting device either with the lamp foot or with the part of the stem near the foot of the lamp by springs.

Damped Electrical Relays.

1428.—1910. Siemens & Halske, A.G., Berlin. The delay in the movement of the armature which is necessary to prolong the time taken in a switching process is brought about by an electro-magnet braking device in which the broke members are in rapidly and equally succeeding intervals of time held against or released from one of the parts to be moved.

Control Apparatus for Vapour Electric Rectifiers.

1482.—1910. R. P. Jackson & H. M. Scheibe, Wilkinsburg, U.S.A. The relay switch for starting the rectifier after an interruption has occurred, is provided with a device which locks the switch in an intermediate open position when the relay magnet coil is only slightly energised.

Regulation of Electric Frequency Converters.

6125.—1910. Siemens Schuckertwerke, G.m.b.H., Berlin. This method of regulating the voltage phases of a frequency converter consists in adjusting the angular position of the rotor of the converter with respect to the angular position of its driving shaft.

Semi-Automatic Telephone Exchanges.

6875.—1910. Siemens & Halske, A.G. Berlin. The object is to connect at the preliminary selector of a calling subscribers line an idle connection of a disengaged operator and also to effect the release and return it to its normal position by the interruption of the testing circuit at the conductor end of the conversation, of such preliminary as was locked in the selected position by the holding on current over the testing lead belonging to the engaged connector so long as the conversation lasted. This is effected by connecting the testing lead to switch contacts at the corresponding connector in such manner that while the connector is in use the holding on circuit is kept closed over the testing lead while the common lead of the connectors is cut off.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year.							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	July 15	1,422	1,452	— 29	+ 94	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940,	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	July 10	1,113	1,107	+ 36	+ 247	24 14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	July 9	6,753	9,098	— 2,345	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·58	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·34	2,864	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·23
Bradford Corporation	July 9	5,239	4,965	+ 274	+1,480	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	July 17	1,056	1,038	+ 18	— 426	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	July 15	6,456	5,800	+ 656	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	July 16	1,313	1,256	+ 57	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	July 17	272	275	— 3	— 43	6½	6½	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	July 16	5,673	5,294	+ 379	+ 797	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6 822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	July 17	3,002	3,088	— 86	— 152	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	July 14	580	537	+ 43	+1,696	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·48
Croydon Corporation	July 1	1,681	1,463	+ 218	+ 2,473	11½	—	Mar. 31	74,132	16,277,418	1,884,187	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	July 15	185	159	+ 26	+ 1	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	July 15	6,398	5,681	+ 717	+ 657	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	+ 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	July 16	1,074	1,026	+ 48	+ 399	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	July 9	17,857	16,719	+1,138	+ 7,705	194½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·87
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	2·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·18	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	July 16	2,704	2,481	+ 222	+ 2,627	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	July 13	133	135	— 2	— 93	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 5	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	July 13	1,458	1,347	+ 111	— 448	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	July 10	1,457	1,443	+ 14	— 111	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	June 25	43,207	39,829	+ 3,378	+ 74,634	132½	118½	Mar. 31	1,274,660	279 166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+ 57	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	July 16	10,703	10,084	+ 619	+ 1,499	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	July 17	17,261	16,956	+ 305	+ 834	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,710	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	July 9	3,794	3,709	+ 85	— 490	60½	59½	„ 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,096	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	July 10	6,076	5,499	+ 577	+ 5 214	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	July 13	1,155	1,073	+ 81	+ 1,118	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	June 29	142	133	+ 9	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	July 9	1,027	1,063	— 36	— 458	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	July 7	2,498	2,464	+ 34	+ 1,203	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

* Train Miles. † Half-year's figures.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

Old Series, Vol. LI.
New Series—No 5, Vol. XLVI.

LONDON, JULY 29, 1910.

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NOTES.

Success of Railway Electrification.

The London, Brighton and South Coast has had the same experience as other railways, the electrification of an urban line has not only recovered all its lost traffic, but brought about a healthy natural increase. Novel as were some of the features in the electrification of the line between Victoria and London Bridge, it has proved a big success. Little wonder that it is now proposed to extend the electrification from the urban to the suburban section; that is, to carry it on to the Crystal Palace. This kind of movement is gaining favour. The experience up North has also been gratifying, but so far main line electrification appears to be as far off as ever. Even the London, Brighton and South Coast Railway, with its success full upon it, and its desire for more electrified lines, is about to build several additional heavy Atlantic express engines. Other railways are very busy with huge locomotives. Nevertheless, main line electrification may come much sooner than the generality expect. At all events, the capital field day on this subject in Great George-street to-day ought to advance matters considerably.

Municipal Telephones.

Hull has been put at ease. The Corporation telephone system is so generally appreciated that some nervousness was felt over the approaching absorption of the National Telephone Company by the G.P.O. Would the Government wish to disturb the municipalities? And so a question was asked in Parliament by Mr. Bentham, M.P. (a member of the Hull City Council). The reply was that Hull would be left alone if the desire for retention was general. As it is claimed, and the claim is fairly substantiated, that the municipality gives a splendid service and, at the same time, saves the business community over £16,000, that desire is very naturally strongly expressed. It is pleasing to learn on the authority of Mr. Byng, Chairman of the General Electric Company, that the General Post Office is reversing the order of affairs that prevailed with the National Telephone directorate, and is taking its telephone equipment from home manufacturers. Besides its own factory, it is keeping other people very busy, including the General Electric Company, which augurs well for future extensions and efficiency.

South African Outlook.

We referred recently to an official South African report which stated that a local iron and steel industry could not be looked for as a paying concern for many years to come. Even the working up of scrap by means of electric furnaces was not advocated. However, this last experiment is to be tried on a fairly large scale. The South African Steel Corporation is shortly to be registered in the Transvaal with a capital of £200,000. The initial plant is to consist of one five-ton Héroult furnace for the electric smelting of scrap, which, it is expected, will be working within 12 months. The first products will be drill steel, castings, railway castings and axles. The Corporation will also test the possibilities of using the Transvaal iron ore deposits. Power will be obtained from another important enterprise. Mr. Howard Pim, acting on behalf of the Transvaal Hydraulic Power Syndicate, has secured a licence for the installation and working of an electric generating station at Tweefontein, district of Middelburg. The station is to use small and second-class coal from the Tweefontein colliery, and is to obtain its water from storage reservoirs on the Olifants River and the Zaaiwater and Piet Spruits, whence the water will be brought to the station by means of pipe lines. It is proposed to form a company with a nominal capital of £926,000 to take over the undertaking. Another prospective customer on a big scale will be the proposed Tweefontein electro-chemical works for the manufacture of nitric acid, cyanide, calcium carbide, fertilisers and other chemicals.

Australian Tariff.

A Supplement to the Customs Tariff Guide shows the following Commonwealth decisions as to electrical apparatus: Bolts, insulated, used on overhead trolley wires to fasten the wire supports to the live trolley wire; cells, electric, parts of, viz., jars, except of glass, zincs; cells, vulcanite, for galvanic cautery batteries. This latter (according to a revised decision) pay 17½% *ad valorum* on the general tariff, and 10% on the United Kingdom preferential tariff. In the telephone section, the frames of the antiseptic transmitter attachment are to be admitted free, while the oiled paper discs are to pay respectively 30 and 25% according to country of origin; while electric valves for protection against resonance are to be admitted free from any source.

Tasmania as a Market.

Tasmania offers a good market for British electrical machinery and enterprise. The islanders are keen on hydro-electrical schemes and on electrification generally. Among the latest developments is the bringing practically to a conclusion the proposal to install a big power station on the Derwent River. The company formed for this purpose intend to erect a concrete weir, to raise the level of the river by upwards of 10 ft. It is estimated that about 2,000 h.p. could be obtained with a 10 ft. head, while 5,000 h.p. might be obtained from a 20 ft. head. The primary object of this enterprise is the manufacture of calcium carbide, a branch of industry unrepresented in Australia, although the Commonwealth imports about £130,000 worth of this product per annum. There is an abundance of limestone on the Macquarie Plains, where this power station is to be erected. But there will be a large surplus of power, and the company propose not only to supply electric light to neighbouring municipalities, but also to furnish cheap power in and around this district, including industrial works in Hobart. Other hydro-electric plant, though on a smaller scale, together with the Derwent, should certainly give a great stimulus for the demand for electrical appliances of all kinds. A point to be noted by manufacturers.

Prepayment Meters.

Trouble has often been realised with penny in the slot meters, either owing to accidental stoppage or the use of discs fraudulently masquerading as coins of the realm. But quite as faulty is the other form of prepayment meters, worked by means of tokens of certain size and weight purchased from the supply companies. This method has its advantages, as it gives a fair basis on which to estimate the amount of current likely to be required. It is clear, however, from the reports of a case heard before the Manchester Stipendiary, brought by the Trafford Power and Light Supply, Ltd., that these useful instruments are open to abuse. The company had reason to believe that certain consumers were obtaining and using more units than they paid for, and it turned out on inspection that at least one ingenious person was causing the machine to

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work without duly feeding it with the prepaid 3½d. tokens. What he did was simply to take a loop of copper wire, insert it in the slot, and so manipulate the mechanism that it worked freely. The too clever person had to pay 20s. and costs; but the most urgent thing to do is to so modify the meter as to make the introduction of the insidious wire impossible, or at least ineffective.

Electrical Surgery.

Operations by means of the electrical cautery, or the electrically heated loop of wire or knife, have long been known and practised, with especially beneficial results as regards operations on the tongue and internal organs, where hemorrhage has to be feared. Now, however, a further advance is suggested by Professor d'Arsonval, of the Academie des Sciences, who has done so much in connection with the curative application of electricity, and the study of its effects on the living organism. He has for some time past been applying high frequency currents to limbs of animals, and gradually bringing up the temperature to a very high degree, ending in destruction. In this way he has been able to remove limbs without any apparent ill effects on the animal. The limb is simply baked, withers and drops off. It is suggested that the system might be applied in cases requiring amputation in the human being.

Aluminium and Electro-Depositing.

If the rumour that a German firm have succeeded in electro-depositing copper, nickel, silver and gold on aluminium proves true, a great thing will have been achieved. Aluminium has many advantages, among them being its low specific gravity and its cheapness. But it has the fault of being quickly attacked by alkalies. Hitherto it has been found impossible to protect the surface with a thin coating of electro-deposited metal, because, as in soldering, the coating of oxide which is always present on aluminium could not be removed. It is now claimed that the Germans have found a means to overcome the difficulty, and so have been able to deposit nickel, silver and gold by the electrolytic method. The thinnest coating is quite sufficient as a protection. This should make the light-weight white metal of increasing advantage in electrical engineering and aeronautics.

Judicious Advertising.

The Electricity Department of the Metropolitan Borough of St. Marylebone have just issued two handsome and very well compiled pamphlets. One, entitled "Other Uses," is a list and description, with illustrations, of many economical appliances for using electricity for other purposes than lighting, and gives many useful hints and details. The other pamphlet deals with "Systems of Charging for Electricity" in vogue in St. Marylebone. The merits of the different systems for special purposes are clearly set out. Altogether these are two admirable productions, and are good types of judicious advertising for central stations. More of this kind of thing is necessary in order to educate the public, who are only to be convinced by constant and emphatic repetition.

Metropolitan Prices.

Some of the papers in reviewing Stepney electricity accounts made a special feature of Mr. Tapper's statement that his average price received, viz., 1·458d. was the lowest price in London last year. We understood that Mr. Tapper meant to infer the lowest "published price." At Poplar the average charge is 1·287d., therefore, Poplar still continues to hold this record as in the past few years. The large difference is principally due to the supply in bulk of 1,027,429 units to Stepney, but even deducting these units, Poplar charges are still considerably below the average of any other undertaking in the Metropolitan area. It should be noted that although Stepney took a fair supply in bulk, their total coal cost fell below that of the two preceding years, and was only 0·007d. above the lowest record of the undertaking. At the same time Poplar did not suffer, as the net profit for the year was 31% greater than the previous year.

"Blazing New Trails."

This is the characteristically Western heading which Mr. Charles A. Parker sets to the ninth of his vigorous series of articles on central station advertising in the current issue of the "Electrical Review and Western Electrician," of Chicago, from which we venture to extract the following passage: "What is the central station doing to forward the use of electrically-propelled vehicles? Now that electric vehicles are coming into their own in all parts of the country this question should be interesting to every progressive central station advertiser. As current consumers electric vehicle owners are very profitable patrons and the wise advertiser should certainly supplement the efforts of the manufacturers to overcome the prejudice that has hitherto existed against this type of machine. As pleasure vehicles for social purposes, their place is now assured, but even more interesting than this is the fact that they are proving strong favourites for commercial uses." We commend this hint to central station managers in this country.

"Trading" v. Municipal Electricity.

As a result of the recent Conference of the Municipal Electrical Association at Glasgow, the Dundee Electricity Committee have been asked to support the agitation for an Act giving power to all municipalities to provide appliances. A good deal of discussion arose, several members being anxious that contractors should not be interfered with. Mr. Richardson, the borough electrical engineer, pointed out that Glasgow possessed these very powers, though they were not exercised; but they enabled considerable pressure to be brought to bear, and permitted of appliances been lent for trial purposes. In fact, Glasgow's experience, like that of Kingston-on-Thames cited here, and many another corporation, was that in order to make an electricity undertaking pay, it was necessary to "push," and for this purpose it makes all the difference in the world if the undertaking is in the position of a gas concern, to carry out work and to let or sell appliances. Nine cases out of ten, it would not be needful to exercise them, because the dormant possibility of competition would give the sufficient stimulus to the contractors. Moreover, the powers asked for would enable municipalities to introduce new inventions which local contractors might not care to touch.

ANOTHER OSRAM INNOVATION.

In several previous issues we have given particulars in regard to the extraordinary length of time that certain Osram lamps have been in use for street lighting in various parts of the country, and in this connection it is interesting to record that occasionally the metal caps have been found to become actually eaten away through prolonged exposure to the elements, before the filaments had failed. We now learn from the manufacturers, that on this account they have decided in future to supply high candle-power Osram lamps with practically indestructible plated copper caps, instead of brass as heretofore. It is, indeed, remarkable that the filament should outlast the cap in the manner recorded, but such has proved to be the case on many recent occasions.

PERSONAL.

Mr. Walter H. Derriman, B.Sc., A.C.G.I., A.I.E.E., Fellow of The Chartered Institute of Patent Agents, has entered into partnership with Messrs. Dicker & Pollak, Chartered Patent Agents, of 37, Furnival-street, Holborn, E.C., and in consequence the name of the firm has been changed to Dicker, Pollak & Derriman. Mr. Derriman is personally taking charge of the electrical business of the firm.

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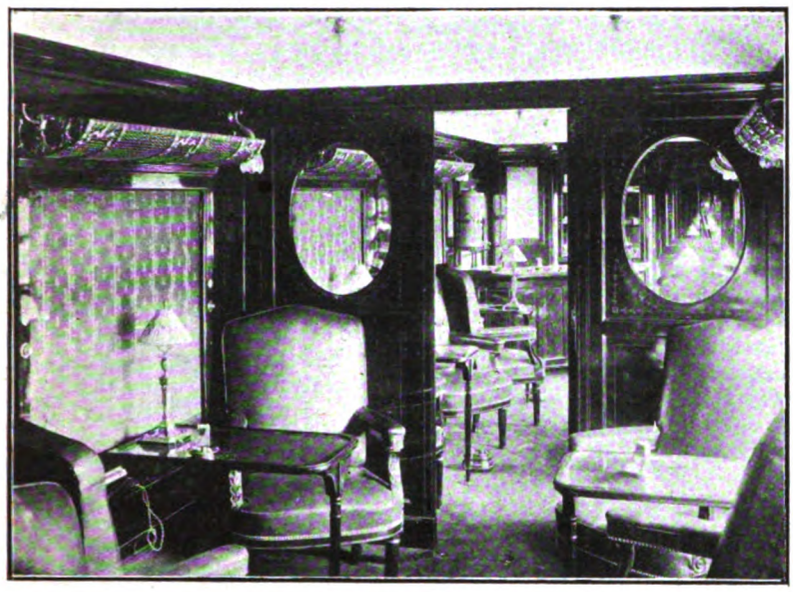
PULLMANS ON THE METROPOLITAN.

A Progressive Railway Policy and some Recent Developments.

Just at the present moment, when British and American engineers in joint meeting in London are discussing various problems in connection with the electrification of railways, it may not be inappropriate to make brief reference to the new departure which has recently been inaugurated on the Metropolitan Railway.



PULLMAN CARS ON THE METROPOLITAN.

During the past year or so the administration of the Metropolitan has been marked by a spirit of enterprise which, even in an era of striking developments in regard to transit, has become especially noteworthy for its prompt response to the needs of the travelling public. Electrification once successfully accomplished, the attention of the management was directed to the organisation of numerous improvements in the service. One of the most important of these was in connection with the section of the line which used to be known as the "St. John's Wood Extension," which runs from Baker-street through St. John's Wood, Finchley-road, West Hampstead, Kilburn (for Brondesbury), Willesden Green (for Cricklewood and Hendon), and so through Kingsbury, Neasden and Wembley Park to Harrow, and on to Rickmansworth, Chesham, Amersham, Wendover, Aylesbury, and Verney Junction, traversing in the course of the journey some of the most beautiful scenery in England.

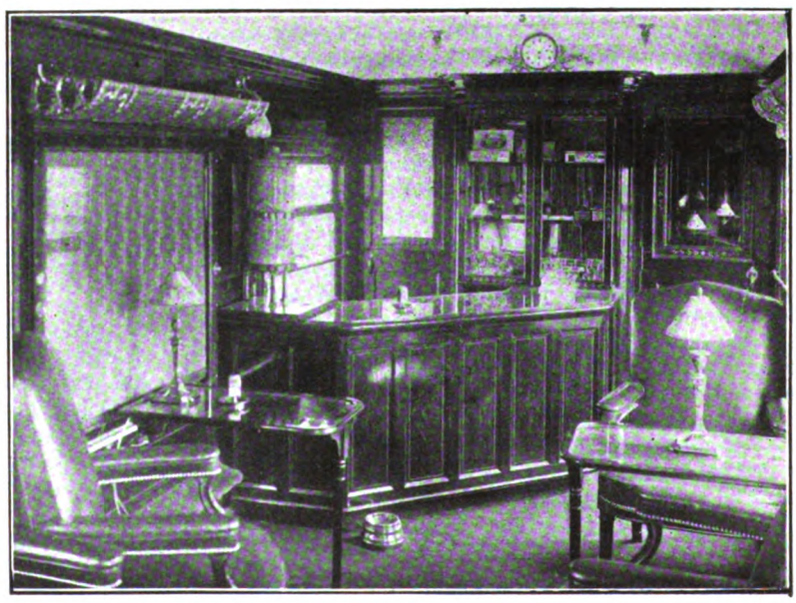
Until within the past twelve months or so Baker-street was virtually the terminus of this section, passengers for the City having to change at that station in order to reach the trains running on the older section of the line. Under the then existing conditions it was only found possible to run one train a day through the single line connecting with the up-road of the old "inner circle" and thus make direct connection between the extension and such important stations as King's Cross, Farringdon-street, Moorgate, Liverpool-street and Aldgate. An improved system of automatic electric signalling, the construction of a new crossing to the down road, and a careful re-arrangement of services made it possible gradually to increase the number of trains running on the single line through Baker-street to the City-road, and at the present moment a service of 33 trains each way to and from the City is run through Baker-street on the Harrow, Uxbridge and Aylesbury lines without in the least degree interfering with the other services on this exceptionally busy line. It speaks volumes for the efficiency of the running staff that although in the "rush hours," morning and evening, there is a two-minute service of trains on the inner circle, and the down-service to the Harrow and Uxbridge line has to cross the up-road a little way outside Baker-street, the service has been run practically without a single mishap, and with a punctuality which is almost phenomenal.

In addition to this great boon of a through service to and from the City under conditions which until quite recently were regarded as practically prohibitive, the Metropolitan has now in regular running a series of morning, evening and night trains to which luxurious Pullman cars are attached. By arrangement with the Pullman Company, Ltd., the chairman of which is Mr. Davison Dalziel, M.P., two cars of this type, specially designed and improved to meet the requirements of the Metropolitan Company's traffic began running on this line on June 1, and the experiment was found so successful that at the present time Pullmans are run to the City on five trains daily from Harrow, on four trains daily from Aylesbury, Stoke Mandeville, Wendover, Great Missenden, Amersham, Chorley Wood, and Rickmansworth, and on three trains from Chalfont Road, Northwood, and Pinner. A similar service runs daily from the City to these stations, the journey from Liverpool-street or Moorgate-street to Aylesbury occupying from an hour and a half to an hour and 40 min., according to the stopping schedule.

An official description of the cars gives the following particulars of the principal dimensions :—

	ft. in.
Length over buffers	59 6¾
Length over platform	57 6
Length over body corner pillars ..	51 0
Centres of bogies apart	39 3
Wheel base of bogies	7 6
Extreme width	8 5
Height from rail to top of roof	12 0

The bodies and underframe are built in one, and the entrance vestibule and end portions of the corridors are panelled in mahogany, the floors being covered with special rubber tiling. The exteriors are finished in the standard "Pullman" colours, namely, umber bodies and upper panels in white lined with gold ; the roofs are painted white and the underframes and bogies black. The cars are divided into two large saloons, one capable of comfortably seating eight passengers and the other seven, and there is also a smaller saloon at one end arranged to seat



THE BUFFET.

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four. The latter compartment can be reserved and shut off entirely from the rest of the car. All the compartments are provided with tables, fitted with electric standard lamps and bell pushes. A well-fitted lavatory compartment is also provided at one end. The end saloon contains a commodious buffet counter, behind which is a pantry fitted with gas stove, hot and cold water, and every convenience for the supply of refreshment.

The scheme of decoration of the car known as the "Galatea" is that of the latter part of the eighteenth century. The mural scheme is composed of panels of fine fiddle-back mahogany, with the upper panels inlaid with satinwood on a ground of fine quartered and veneered fiddle-back mahogany. There are eight flap tables in the car, which have glass tops and on which are placed electric lamps of chaste design. Each compartment has a cored plaster ceiling with an ornamental band on the flat forming a panel. From this band are suspended the ceiling lights. Wall brackets are also fixed at suitable places on the wall panelling. The bell pushes, switches and number frames are of ormolu, finely chased and gilded. The blinds, which are of green silk damask, have been specially woven. Above each blind there is an ormolu baggage rack, with finely chased ornamentation with panels of brass treillage. The floor is covered with a green deep pile carpet, and the chairs are luxuriously upholstered and covered with green morocco. The upper panels of the cross partitions are of clear plate glass, thus enabling one to see from end to end of the car. The "Mayflower" is decorated in the Georgian style, and the combination of the oak and the holly makes a most pleasing effect. The mural scheme is composed of panels of fine wainscot oak, with the upper panels inlaid with enrichments of the Georgian period on a ground of fine quartered and veneered oak. The car is divided into three compartments with cross partitions. There are chairs for 19 persons in the car and patent hinged tables with plate glass tops.

The cars are British built throughout, the whole of the construction having been carried out in the works of the Birmingham Carriage and Wagon Company at Smethwick. The interiors were designed by Messrs. W. S. Laycock, Ltd., and the entire construction has been to the approval of Mr. C. Jones, the Metropolitan Railway Company's Locomotive and Carriage Superintendent, and under the supervision of Mr. Thomas Powell, secretary and manager of the Pullman Company, Ltd. The cars are available for use by the holders of first-class tickets, either single journey tickets or season tickets, upon payment of an extra fee of 6d. per passenger as between London and Rickmansworth and intermediate stations, and 1s. as between London and the stations north of Rickmansworth. Light refreshments are served on the cars, including breakfasts on the morning trains, luncheons at mid-day, tea in the evening, whilst supper will be obtainable on the theatre train leaving Baker Street each week-night at 11.35 for Harrow and other stations as far as Aylesbury.

In announcing the new service, the company observe that the districts of Middlesex, Hertfordshire and Bucks, served by the Metropolitan Company's line north of Harrow are daily growing in popularity as high-class residential areas, and it is admitted that there is no more beautiful and more health-giving country than that of the Chilterns and their surroundings. "Men of business, who by living in the country require to spend upwards of an hour morning and evening in the train, will undoubtedly appreciate the extra comfort which the Pullman cars provide, whilst golfers, theatre-goers, and others will be able to save time by taking their lunch or supper while they are travelling to the links or to their homes." Nevertheless, the experiment must be admitted to be a bold one; and we are glad to be able to record that in this, as in so many other respects, the progressive policy of the Metropolitan, under the able direction of Mr. R. H. Selbie, the general manager, and his staff, is meeting with the success it so thoroughly deserves.

INSTITUTION OF CIVIL ENGINEERS.—The King has been graciously pleased to become patron of the Institution of Civil Engineers, of which Institution he was an honorary member for 17 years before his accession to the Throne.

THE MODERN OIL SWITCH.

Systems of Moderate Voltage and Large Ampere Capacity.*

By A. R. Cheyney.

The oil switch has become a fundamental part of all large generating systems, and so well has it fulfilled its function that not only has it superseded practically all other forms of switches for such service at all voltages, but manufacturers unhesitatingly claim that it can be constructed so as to safely open short circuits under the worst possible conditions in systems of unlimited kilowatt capacities, the only limiting condition, of course, being that the consumer be willing to pay for it.

In spite of this assurance, repeated warnings that the present switches are becoming a source of possible danger in the rapidly growing central station systems of our large cities are being heard, although neither manufacturer nor operator has seemingly thus far placed any absolute safety limit on just how large a system the present switch is entirely capable of protecting.

Switches may be divided into three classes, each class being further sub-divided into extra high voltage, moderate voltage and low voltage. The three main classes are based upon the maximum generating capacity that the switch may reasonably be called upon to interrupt. The classification, therefore, becomes in fact switches for small systems, for systems of moderate capacity, and switches for use in systems of the largest size. So long as the operating man does not object, the rating of this latter type of switch will continue to be for systems of "unlimited capacity," as any experimental evidence to the contrary is at the expense of the operating system itself.

It is further manifest that oil switches may be built to safely and continuously carry any current that may be required. The use of the switch as a circuit-breaker is the limiting factor in the case. Every switch thus used must not only be able to safely carry or interrupt the load of its particular section, but it must also be capable of safely and repeatedly interrupting short-circuits under severe conditions, with the whole capacity of the generating, transmission, and receiving systems behind it.

The switch with which this paper is mostly concerned is the type almost universally used in the large generating systems of our cities, where the voltage usually runs from 13,000 to 6,000 volts per phase, and is manufactured in various sizes, the 2,500-volt switch with a capacity up to about 3,000 amperes, the 15,000-volt switch up to 2,000 amperes, and the 35,000-volt switch up to 300 amperes rated capacity. Under these conditions the temperature rise in the oil cylinders or tanks is generally kept as low as possible 28° C. being sometimes specified.

The switch of both large and small ampere capacity for extra high potential systems seems to have rapidly made a place for itself in the high-tension transmission systems of the country, and to have been extremely satisfactory in most instances. One 60,000-volt switch, it is claimed, opened twenty-five consecutive short-circuits, with a generating capacity of 10,000 kilowatts, within a space of one-half hour, and although the oil was carbonized to a considerable extent, the switch opened the arc entirely satisfactorily on the last break. In another instance two 60,000-volt breakers which had been in service for three years, have opened several hundred short-circuits, many of them severe, without a change of oil. The generous dimensions of these switches are sufficient to show that the design is amply safe with regard to distances between conductors, the manufacturers claiming that they figure on an oil which has dropped in insulation until it may be broken down from 6,000 to 10,000 volts on a 0·2-in. gap between needle points. It is impossible in practice, with systems of this nature, to maintain the oil at an exceedingly high insulating value without a great deal of labour and inconvenience, particularly on account of the moisture that is absorbed from the atmosphere. In these switches for high voltage systems, which are now on the market in capacities up to 400 amperes at 110,000 volts, experience

* Paper before the 27th Annual Convention of the American Institute of Electrical Engineers, June, 1910.

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seems to show that a large volume of oil greatly increases the factor of safety. Some manufacturers also claim that in switches of this class a horizontal is superior to a vertical break as the pressure due to the head of the oil above the contacts is more effective in preventing the arc from reaching any large dimensions. Switches with a horizontal break are usually made with a thin knife blade in order that it may cut through the oil with the least disturbance. Judging from the written expressions of the users of these high-tension switches, it is evident that for the conditions under which these switches operate they are giving very satisfactory service.

Until the introduction of the steam turbine, with its high rotative speeds and correspondingly low self-induction, the present plunger type of switch seemed to fulfill every expectation in moderate voltage systems of large generating capacity. The enormous growth of connected load, and, at the same time, the adoption of the turbine as a prime mover, have brought about conditions unforeseen; and not only has the ability of modern switch construction to safely care for the new conditions been questioned, but experimental evidence would lead to the conclusion that either a new form of switch is urgently needed or else a marked change in switchboard construction and station operation.

The high-power switch for 6,000 to 13,000-volt service has at all times required careful supervision, constant attention to smaller details of its operating mechanism, and periodic tests, in order to ascertain that it was always ready for service. This, of course, is not unreasonable. Heavy short-circuits, however, have frequently demonstrated the fact at the present time in our large stations no circuit-breaker which has once opened under heavy short-circuit conditions is entirely safe to be put back on the line again without a thorough overhauling of contacts, cleaning up of the switch and its compartments, on account of the large amount of oil which has been blown out by the explosive pressure of the arc, and also the refilling of the switch cylinders. It is frequently necessary to insert an entirely new set of contacts and to file down the rod tips. This whole operation involves a period of at least two hours, and if spare feeders are not available, may lead to considerable annoyance, while, in any case, it may involve a temporary disablement of a large and important investment in apparatus.

Changes, such as the substitution of steel for brass pots, the addition in some instances of insulating dashers to assist in keeping the oil within the pot and also to facilitate the breaking of an arc, and improved operating mechanism and contacts, cover practically all the main points that have been improved upon, since the introduction of the 8-in. cylinder eight or ten years ago, notwithstanding the enormous increase in maximum short-circuit output of the turbo-generator over that of the engine-driven alternator of equal capacity and the fact that the size of units has increased from 5,000 kw. to 20,000 kw. The substitution of boiler-iron tanks for wooden tanks and the gravity opening, with a means of obtaining a certain forced oil flow across the contacts on opening the switch, are a few of the changes in another type.

The Committee on High Potential Disturbances of the Association of Edison Illuminating Companies, 1909, notes that several of the larger companies are making use of reactances in connection with their turbines. These are installed either in the neutral leads of the turbo-generator, or in the phase leads themselves. The reactances also facilitate parallel operation. A committee of the same body during the previous year suggested a limit of 40,000 kw. of installed machinery as a maximum generating installation that could be safely protected by a modern switch. As, in several instances, the switch has caused considerable damage, frank discussion in the line of improvement of the switch design is asked for.

As a matter of record, with 15,000 kw. of turbines in service, the latest type of oil switch has been quite recently practically emptied of its oil, the remaining oil being reduced to a state of absolute blackness and the contacts and rods so badly burned that they were unfit for further use without renewing, makes it evident that some change is needed in our present switchboard or switch design.

Modern operation generally calls for the use of a single operating bus-bar for reasons of both reliability and economy. Choke coils to limit the generating capacity in one section of the bus to a value of perhaps 20,000 kw., or a capacity slightly above that quoted when the switch was disabled, would seem hardly practical. As the load continues to grow with enormous strides, it would certainly seem that a more powerful type of switch should be found. As far as ascertained, resonance rises of potential due to the opening of an arc in an oil switch are of comparatively rare occurrence. It is natural to suppose that, whatever changes are made, the arc will still be broken under oil.

A few remarks of a general nature on switchboard construction and arrangement may not be out of place. A feeder switch, or circuit-breaker includes properly the knife switches separating the switch from the underground cable system, the series transformers, relays, control wiring and the switch itself with its fireproof compartment. It would not, therefore, seem illogical to adopt a type of construction in which all of these parts are relatively close together, instead of being scattered perhaps hundreds of feet apart, as is frequently the case. For instance, the series transformer, the relays, the current through the coils of which, incidentally, should also pass through the circuit ammeters of the operating board, and the actuating mechanism of the switch belong together. The cable knife switch should be so placed as to be visible when working on the circuit-breaking switch itself—in other words, in the base of the switch compartment. The bus-bar knife switch should also be visible to any one working on the selector switches to obviate any chance of mistake in switching, and, furthermore, to protect the operator. This means, then, the bus-bar and selector switch compartments must be one, so constructed that every switch section is independent and that the complete demolishing of one switch will not in any way affect either the neighbouring switches or the bus-bars themselves. This arrangement, mentioned above, will not only greatly reduce the space required for present switchboards, but will assist materially in proper maintenance and repair.

It is possible that it may become good practice where the plant equipment includes two switches in series for each feeder—one automatic and the other non-automatic—to allow the time element relay to open both switches in order to assist in breaking the arc, although this should not be necessary with a reliable switch. In connection with the use of choke coils the suggestion has been made that these coils be short-circuited by a heavy switch which would be opened by a relay when required. It is doubtful if any switch yet constructed would be quick enough to give the effect desired, and on this account, and also on account of simplicity, choke coils, if installed at all, should be so designed as to care for operating conditions without the intervention of an iron core or moving mechanism.

As an illustration of the exceedingly heavy duty required even of a 300-ampere switch on a single feeder cable in the case of a 50,000 kw. steam turbine station of 6,000 volts, the instantaneous short-circuit current would amount to $50{,}000/\sqrt{3}\,E \times 50 = 240{,}600$ amperes per phase, or a kilowatt output, assuming a power factor for the short-circuit of 40%, of $50{,}000 \times 50 \times 0{\cdot}40 = 1{,}000{,}000$ kw.

A 100,000 kw. plant under similar conditions would give an output of 2,000,000 kw. It is expecting a great deal of a 300-ampere switch to suppose that it could be safely figured on to care for such an enormous amount of energy. Yet the facts remain as stated. There are several modifying conditions, however, which enter into the problem. In the first place, short-circuits as a rule are not absolute short-circuits, and in this way the number of amperes actually interrupted is probably far less than that calculated. It must also be borne in mind that even if a circuit-breaker on a feeder were provided with an instantaneous relay, the time element of the switch itself is considerable, so that by the time the arc had been opened, the armature reaction of the machines would have, to a certain extent, become effective, thereby dropping the voltage and still further lowering the amperes at the break. If the safety of the switch alone is considered, it would doubtless be expedient to instal inverse time element relays in connection with the feeders which would give an exceedingly long time interval in connection with the 100% or more overload setting of the breaker, in order

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that they might give perhaps a three or four-second interval between the occurrence of the short-circuit and the opening of the switch. While specific information with regard to the length of time which is required for the armature reaction of alternators to become effective is lacking, there is on doubt that a mean might be drawn between conditions most favourable to the switch and those upon which depend the stability of operation of the main and sub-station synchronous machinery. Were it not for the possible rise in potential due to the breaking of the arc when the current is perhaps at a maximum instead of at zero point of the wave—which is another fact upon which further light is much needed and upon which the oscillograph without doubt will prove of great assistance in effecting a solution—the operating man would much prefer to have a short circuited cable cut off instantly before the trouble has had time to reach its heaviest proportions or has become severe enough to interfere with the frequency or voltage of the system.

The problem of the oil switch demands the more nearly exact solution of these questions. The protection which might possibly be afforded against the effect of static surges by the aluminium cell arrester might well be considered in this connection. With this protection, it would seem that the advantage lies practically altogether in favour of opening the switch itself as quickly as possible, by which it is understood that the greatest reasonable amount of time should be given by means of the relay to the switch before the latter starts to open the arc without, on the other hand, taking chances of throwing off the synchronous machinery. Under the best of conditions, however, we can but see that the switch is a relatively weak link in a system involving millions of invested capital.

The breaking of a circuit consists of inserting more or less gradually into the circuit a resistance which grows at a variable rate from zero to a maximum. At the moment the switch is leaving the contact, the greater the $C^2 R$ loss in heating, and especially if the circuit be inductive, the greater the amount of arcing. The rapid falling off in amperes as the resistance is increased by distance, when a considerable amount of metal is vaporized, and by this means the breaking of the arc is considerably hindered, is probably not at first accompanied by any great drop in the heating effect on the oil and the contacts, the $C^2 R$ loss for a certain length of time being perhaps practically constant. This, in part, is probably the cause of the explosive pressure set up in the cylinder by the oil vapour assisted by the actual displacement of oil by the arc itself. The prolonged arcing is evidently also the cause of the large amount of carbonization which takes place on opening a heavy short-circuit under oil with the modern switch.

Although there has not been a great deal written upon the exact nature of what takes place when a heavy arc is thus broken, experimental evidence has shown us that the quality of the switch oil will without doubt play a very important part in the switch of the future. The electrostatic stress set up between two charged conductors in a light mineral oil such as is used in switches and transformers, will, under proper conditions, even though no appreciable current is allowed to flow, release considerable quantities of gas without appreciable change in the oil itself, and as this gas is naturally rich in hydrogen, may it not be that the explosive violence of some of our short-circuits is due to the combination of this gas and the gas driven off by the heat of the arc with oxygen, possibly of the air? The carbonization which takes place when a heavy short-circuit is broken is sometimes sufficient to make a deposit on settling of $\frac{3}{4}$ of an inch in a 4-inch column of oil, or a total volumetric proportion of 10% between the amorphous carbon and the clear oil above. The actual sample measured was taken from an oil switch cylinder from which two-thirds of the oil was blown out by the violence of the explosion. The physical analysis of the fresh oil (No. 6 transil oil) was as follows:

Flash	353 deg. fahr.
Burn	402 " "
Gravity at 60 deg. fahr.	31·4 B.

As regard acidity, the oil was very nearly neutral, 0.09% of potassium hydrate being required to neutralize same. There was no organic matter present. Various tests were made to ascertain the specific resistance and the dielectric strength of the above oil under the following conditions:—First, the new oil; second, the blackened oil as taken from the switch; third, the clear oil after filtering off the carbonization. Careful tests were made under different conditions such as the sparking distance between needle points, between flat discs, between two $\frac{3}{4}$-in. balls, between a needle point and a disc, between a needle point and ball, etc. In some of the tests it seemed that the filtered oil after heavy carbonization showed an increase in specific resistance over the new oil. The dielectric strength also seemed materially increased after carbonization and filtering. The carbonized oil as taken from the switch showed a specific resistance of only one-fourth that of the new oil or of only one-eighth the resistance per cubic cm. of the oil after removing the carbonized particles by filtration, although another series of tests of other samples of the same oils failed to confirm the above figures; still, there was a marked difference between the samples, although any increase in specific resistance or in dielectric strength failed to materialize except in one instance. The following figures, however, which are abstracted from the second series of tests, represent the sparking distance between two $\frac{3}{4}$-in. balls at approximately 22·5° C. under a depth of oil of $2\frac{1}{4}$ in.:—

Sample.	Gap.	Volts.
No. 1—Blackened oil (filtered)	0.15"	12,000
	0.20"	29,000
No. 2—New oil	0.15"	12,000
	0.20"	29,500

The following figures, representing the break-down point in inches at 30,000 volts pressure, as measured by an electrostatic voltmeter, checked by needle points, are also given:—

Sample.	Needle points.	Needle and $\frac{3}{4}$-in. disc.	$\frac{3}{4}$-in. Ball and $\frac{3}{4}$-in. disc.	Between $\frac{3}{4}$-in. balls.
	in.	in.	in.	in.
No. 1—Blackened oil	0·635	0·610	0·320	0·220
Blackened oil filtered	0·530	0·750	0·250	0·190
No. 2—Blackened oil	0·420	0·675	0·615	0·310
Blackened oil filtered	0·300	0·600	0.290	0·185
No. 3—New oil	0·575	0·755	0·502	0·665

Temperatures in the above table all 26·5°C.

All distances were measured by michrometer, the voltage adjustment being secured by finely adjusted resistances in the primary of a 40,000-volt testing transformer. As this may have introduced possible error due to change in wave form, the figures are given as being perhaps at best only approximately correct.*

Whether or not the changes in an oil produced by carbonization under heavy arcing improves or reduces the values of the remaining filtered oil for use in oil switches, it seems quite urgent that oil for switch purposes be chosen with great care, and manufacturers should make public satisfactory specifications to cover such oils and the testing of the same. It is by no means certain, as is frequently claimed, that a good transformer oil will make a good switch oil. Carbonization under heavy arcing is undeniably unavoidable. The study, however, of the physical and chemical nature of the actual conditions existing while the arc is being drawn through the oil with regard to the oil itself may lead to valuable conclusions that will somewhat strengthen the present oil switch situation.

It may be necessary to reduce the carbon content of the oil or possibly the hydrogen and more volatile components, even, perhaps, at the expense of changing the viscosity. Careful specifications will be welcomed by operating companies.

The severity of the arcing is naturally dependent upon the pressure of the oil surrounding the arc, the temperature of the oil and contacts, the velocity of switch opening, and, of course, by the ampere density at the point of break. The amount of vaporization of the contacts should be

* Other interesting figures in connection with the same kind of investigation are given in a paper read before the Manchester Local Section of the Institution of Electrical Engineers, by W. Pollard Digby, and D. B. Mellis, of which an abstract appears in the London Electrician, April 1, 1910. Important papers on this subject by Messrs. Skinner, Kintner, Steinmetz and others have appeared in the technical press.

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reduced to a minimum by properly proportioning the switch parts, by artificial circulation of the oil across the contacts as they are separated, and by increasing the velocity at the break to as high a degree as is possible. Severe arcing, even under oil, may without doubt be sufficient to set up heavy oscillations in a large underground system and, although much has been written upon the advisability of retarding the switch in its action, it frequently seems very advisable to have an absolute short-circuit broken as quickly as the switch will open it, the limiting factor being the reliability of the switch itself.

The oscillograph in the near future will also doubtless add to our knowledge of the conditions existing in a severe arc closely confined, as in the case of an oil-switch cylinder under pressure. As stated above, there seems to be considerable difference in opinion among engineers with regard to whether the opening of a switch should be in a horizontal or vertical direction. While many of the high-tension switches in the West use a horizontal break, depending upon a large volume of oil and a narrow knife blade for contacts, practically all of the higher-power switches of moderate voltage have a vertical throw, in some cases opening by gravity, which has the advantage that the switch can never accidentally fall into contact; while in other types the switch opens upwards.

There has been developed, although apparently it has never yet been introduced as a commercial article, an oil-switch in which the oil is at all times under pressure which is maintained by a compressed air system—a pressure line of perhaps 150 lb. or 200 lb. caring for a number of switches, and a gravity or return line returning the discharged oil to the system. This principle seems to be exceedingly promising insofar as breaking the arc is concerned, the switch cylinders being either always full of oil under pressure, the opening of the contacts allowing a heavy stream of oil to be forced directly across the arc and through the hollow contact to atmospheric pressure, or, as in another case, where the tripping coil opens an oil valve which admits large quantities of fresh oil under pressure to come into direct contact with the heated terminal directly at the base of the arc. It is undeniable that the mechanical squeezing out of the arc is what we need.

The forcing of considerable streams of cooled fresh oil across the contact face to the atmosphere, thereby eliminating all carbonization and gasification from the oil switch itself, gives a pleasing prospect of what the future may have in store. The breaking of a heavy arc by the weight of a 9 or 10-inch column of oil, especially in small or confined areas, is going to be somewhat of a doubtful matter, especially as the sizes of operating systems increase.

Another matter which should be carefully considered in connection with the vertical cylinder oil switch is the magnetic repulsion between the oil switch cylinders at times of heavy short circuits. Insulator bases are required, of great mechanical strength, to safely withstand this unusual strain, which is perhaps similar in its nature to that which causes the opening of high tension switches under similar conditions, and it may be perhaps that broken base insulators may be traced partly to this cause.

In the matter of oil-switch contacts, practically every form imaginable has been tried, particularly in the smaller switches. It need only be mentioned, therefore, that there seems a strong tendency to rely upon the cooling effect of the oil and the large radiating surface of the pot or oil tank to carry off the heat from contacts which in air would exceedingly warm. An oil-switch contact should, on account of the very nature of the insulating medium, be of at least as large proportions as a similar current carrying contact for use in the air; especially so since carbonization, sedimentation, moisture and other causes may interfere with the contact; and, above all, because it is practically out of sight at all times.

Switches of the more powerful types are generally sufficiently provided as to contact area, but there are certain switches of high current carrying capacity designed for mounting on marble switchboards, for hand or solenoid operation in which the contact surface is naturally too small. The switch, including the oil and tank itself, run exceedingly warm with the contacts most carefully adjusted. This seems a mistake and should never exist in any oil-switch which is placed in a position of responsibility. The temperature of such a switch contact cannot be noticed by handling as can that of a low tension knife switch, so that the greater amount of power per ampere precludes any cutting down of contact area if at the expense of a rise in temperature over normal conditions. Information as to the increase of conductivity of a contact due to increase of pressure is not very plentiful for contacts under oil.

The operating mechanism of large oil-switches can be of the pneumatic, hydraulic, solenoid or motor type. The pneumatic control seems especially adapted for switches of extra high voltage and of certain types, although these switches are very frequently solenoid operated. In the switches of systems of large ampere capacity, the choice between solenoid and motor types of mechanism seems an open one. Both types are fulfilling their proper functions in a satisfactory manner, so far as can be ascertained.

The method of control and the wiring of the same vary with conditions. Generally, the pilot switch that stands in the "off" position and inclining toward the contact last in use is adopted, principally for reasons of wiring connection. The style of pilot switch which remains in contact until thrown into another position is a most excellent switch, and for some reasons, especially in synchronizing, is preferable to the open type, if connections allow of its use. Certain switchboard designers prefer the pull-button switch, where all the contacts are on the under side of the operating table, thus precluding any possible switch action due to the dropping of any conducting body upon the operating table, and thus operating switches at inopportune times.

Generally, the simplest switch seems the best, and with a switchboard comprised of plain knife switches so that the operator can always see that his contact conditions are satisfactory, the limit of simplicity has been approached. Synchronizing by pulling out a switch seems perhaps the least bit awkward as contrasted with throwing it in. Not only is it advisable as stated below that the circuit ammeters shall indicate any open circuit condition of the relay coils, but it is advisable, if possible, that the control wiring be so installed that the operator is informed by his pilot lamps in case of any failure or open-circuit condition in actuating current supply through the relay or the pilot switch itself.

Standardization in the case of oil switches has been made somewhat difficult, so that an excessive number of spare parts must at times be kept in stock. It seems unfortunate that several types of motors, for instance, all of the same general size, speed and voltage shall be necessary, frequently perhaps on account of the changes of the distance between shaft centre and base or a slight change in the base clamping arrangement. The same, of course, applies to motors on governors, main field rheostats, field-brake switches, etc. In laying out a new station the designer should see that the number of types of auxiliary motors are reduced to a minimum, so that instead of six or eight or even more types, two or three will fulfil the conditions.

The interlocking of high power switches has not generally seemed advisable up to the present date excepting through the control wiring scheme. It is, of course, always advisable that this be so arranged that the synchronizing plug or switch shall carry the actuating current of the selector oil-switch so that it will be impossible for the operator to synchronize a machine with one operating bus and throw it on the other. Interlocking is furthermore undesirable in many instances as the buses are frequently doubled up for various operating reasons, this arrangement affording a very flexible means of caring for the everyday happenings of the central station system. In a system in which each generator and feeder consists of a main circuit-breaker and two selector switches any set of selector switches may be utilized for tying together the buses, although the generator switches will generally be used.

Interlocking in the smaller types of switches designed for mounting directly on a switchboard panel or otherwise has not as a rule seemed advisable. The great tendency toward cheapness of production has actually interfered with proper design of some of the smaller switches to such an extent that it is suggested that all unnecessary complications should be avoided and the money invested placed in the switch itself, providing only a first-class yet

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simple operating mechanism. The smaller type of switch may be hand—solenoid—or motor-operated. When used as a circuit-breaker it must be installed in systems within the limits of capacity as given by the manufacturers. Its use on systems of the heavier class is not advisable unless in sub-station installations, when it may be safely used as a single throw device for a bus selector switch, provided that a heavy type of switch is used as a circuit breaker. This lighter switch finds a very abundant field on account of its relatively low cost, especially on voltages from 2,400 to 13,000. It is frequently used as a remote control switch, as a manhole or pole-type switch, and on the outgoing 2,400-volt wires from alternating-current transformer sub-stations. There is lacking, up to the present time, any adequate time element device for this useful switch, so that unless special relays are used on the switchboard, circuit-breaker setting by means of the tripping coils generally means the opening of every switch in the series on short circuit, which is extremely objectionable. The usual practice, therefore, in this connection, is to solidly block everything possible and to remove all blocks only at the time of known danger or when switching. This at best is a dangerous practice and it is hoped that at a near date some satisfactory time element device will be furnished with all such switches for station use, as this will not only make possible selective setting of the various switches, but will possibly protect the switch itself.

In the alternating-current sub-stations of a generating system of any considerable size the double throw form of polyphase switch, in which both of the main bus-bars, for instance, of the sub-station enter one switch, is generally inadvisable, especially in the switches of large ampere capacity and one self-contained oil tank such as is being furnished at the present day. It is preferable to instal two first-class oil-switches, one for each bus, in such a situation that repairs to switches and regular overhauling can be carried on safely and all chances of trouble between buses, and also the necessity of lowering an oil tank with very small clearances while the switch is alive, is practically entirely done away with. This double-throw type of oil-switch, in which the dimensions are reduced to a minimum and the design is influenced to a large extent by commercial conditions, is especially dangerous if used as a circuit breaker. The operating mechanism, furthermore, of many of the switches of this type is very frequently of too light a nature to be consistent with the responsibility thrown upon the switch. Further defects which are brought about by the necessity for economy of space in the same type are weak insulators, and weak insulator support, also the difficulty of aligning the contacts and the contact yoke, and of keeping them in proper alignment. Loose insulators, loose studs, and leaking tanks are of very frequent occurrence with some types of switches.

If light duty switches are installed in situations where they can be called upon to open short-circuits beyond their rated capacity in kilowatts, the oil is badly carbonized, the tanks are liable to become damaged, the contacts burned excessively, and the switch emptied of its oil if not actually short-circuited. The oil tank for these light duty switches should be given an ample margin of security and purchasers of switches, particularly those which are to be used on systems of large size, even though they are not to open exceedingly heavy arcs, should specify tanks of heavy sheet metal properly rivetted and absolutely oil-tight. A great deal of trouble has been experienced through leaking of switch tanks in which, mainly for reasons of cost, the weight of the metal has been reduced until the tank itself is much inferior to that of several years ago. A ¼-in. boiler-plate tank, properly rivetted, is superior in every way to the light weight tanks now so well known. These latter remarks apply particularly to switches for use on switchboard panels. There are certain occasions when commercial conditions step in and a switch is desired at a minimum of cost, even at the expense of a certain degree of security. The operating switchboard of any main or sub-station, however, is not a location where security can in any way be dispensed with.

There is urgently needed a new type of oil-switch of the cheapest form, preferably of the single-pole type, which shall be automatic in case of predetermined overloads, and which shall be capable of being installed in place of present line boxes on overhead 2,400-volt distribution lines. There is a wide field for the introduction of just the right switch in this connection. At the present time the market offers no satisfactory device. As these switches could be made in enormous numbers, and as the design may be made so that the factor of safety, excepting only the matter of insulation, is not exceedingly high, it would seem that it should be possible to manufacture at wholesale such a device that would in a measure compete, even in cost, with the present enclosed fuses and line or man-hole cut-outs.

Experience has demonstrated that constant vigilance is necessary with regard to every part of a generating system if service conditions are to be maintained at the highest point of reliability. Especially so is this true of the oil-switch in large systems. Certain defects can be noticed by visual inspection; others require the operation of the switch one or more times, while the inspector closely watches the mechanism and tanks. Still, others can only be found by actually taking the switch apart and re-assembling it. The inspection necessary, therefore, covers the knife switches, the insulators and contacts, oil-switch mechanism, tanks, rods, base insulators and compartment. To best accomplish this, the work of switch inspection may be sub-divided as follows:—

1. Daily inspection of mechanism, tightening up of possible loose nuts, etc., general cleaning of switch. This covers all that can be observed with a reasonable amount of attention while the switch is in service, and is given every switch, whether carrying current or "dead."

2. Weekly inspection, covering the operation of the switch from four to six times to observe clutch conditions, tripping coils or contacts, open-circuits in wiring, loose parts, bolts, nuts, etc. This test also insures the switch being securely bolted down to its compartment. All doors are taken off or swung open, and tanks, rods, yokes, etc., examined, leaky oil tanks cleaned up, and any dirty base insulators cleaned off. This latter inspection has frequently located broken base insulators, insulators loose in their iron mountings, loose bolts securing base insulators, loose yokes and wooden shalts, and on one occasion a yoke and set of rods which had actually become disengaged from its clamp on the vertical wooden rod and fallen into the closed position, thereby closing one phase of the switch absolutely without the operator's knowledge. Defective alignment of cylinders particularly in the case of the older type of switches, and improper switch action are also thus located. This inspection also locates leaky oil tanks, defective cable connections and terminal insulation.

3. Once a year every switch is completely taken down, each part cleaned and oiled, contacts brightened, supplied with fresh oil, and any minor defects that may have crept in are remedied as far as possible.

These three inspections have been found to cover fairly well the operation of the oil-switch in service. The whole of the work outside of the inspection itself is cared for by one man, excepting that the annual overhauling makes it necessary to add one helper to the force. This is in a plant of some 90 high-power switches.

The yearly inspection has discovered at times defects of a very serious nature which would not have otherwise been located, excepting through the failure of the switch mechanism to operate in service, and also troubles with the switch cylinders, rods or contacts. It is desirable that this systematic inspection be recorded, a separate card being used for every switch on which the various defects are noted. The main purpose, however, as stated above, is that the switches may be in working condition at all times both as to mechanism and the switch itself. Failures to operate when called for, defective contacts, low or defective oil, loose parts within cylinders, defective rod tips, or broken insulators may, any one of them, be the means at a most inconvenient time of causing trouble. Further records of switch condition besides the details given from the above cards are obtained by grouping the various defects in order that the weak points of the switch may constantly be kept in mind. The number of times the switch is thrown under inspection exceeds in all probability the times that it is actually used in service and has a tendency to cause a certain amount of switch trouble itself by loosening the bolts and contacts. It, however, is

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TYPE H SWITCH RECORD—1909.
Minor adjustments not noted.

	In service.	Weekly test.	Yearly overhaul.	Total.
Failed to open	0	0	0	0
Failed to close	6	10	0	16
Pumped	0	5	13	18
Oil renewals..	7	0	81	88
Oil thrown on short circuit	7	0	0	7
Contacts renewed	7	0	13	20
Base insulator loose or broken	0	19	9	28
Failure to open short-circuit	0	0	0	0
Defective contact at brushes	0	0	12	12
Broken castings, bearings, etc.	0	0	5	5
Bent crank shafts	0	0	1	1
Clutch, trip coil and control finger clutches	0	35	2	37
Friction in mechanism ..	0	0	27	27
Troubles with compartments	0	0	2	2
Closed accidentally.. ..	0	0	0	0
Opened accidentally ..	0	0	0	0
Switches operated, times ..				35,000
Short-circuits opened ..	12	0	0	12

the only means available whereby the switch action may be entirely depended upon.

The daily inspection thus eliminates the minor troubles apparent to a trained observer; the weekly inspection makes it possible to practically eliminate all external troubles in the switch compartments and in the mechanism, and especially failures to operate when called upon, whether due to open tripping coils, defective clutch coils or otherwise, and practically insures the switch against trouble due to pumping; while the yearly inspection cleans up the switch as a whole, making it possible to start a new year with switches fresh and complete from top to bottom.

The actual expense for material in switch maintenance is probably equal to the labour item. The results obtained in a year's service, including operation and inspection of some 90 switches, sub-divided into trouble of the mechanism and those of the switch proper are shown in the foregoing table.

In conclusion, it may be briefly stated that the present state of oil-switch development, particularly described above, with especial regard to its continued use in the large installations of the future, has not given the operating man quite the same vision of perfect security and unlimited capacity as he would desire. A more powerful switch is seriously needed, a switch which will stand up in continuous service for at least a year without the necessity for overhauling every time a short-circuit is opened. It would not seem unreasonable to wish for this condition in any piece of machinery; and without doubt the oil-switch will be brought up to the standard desired when the operating companies and the manufacturers get sufficiently close together. The use of oil in the future switch seems assured. The problem is the right way to use it. From the standpoint of the present enormous and growing investments that are being protected by the device, and with a clear knowledge of the result of failure, there is no doubt that between the designer and the user and with perhaps the assistance of the physicist and chemist that the problem will be readily solved, when once its real importance is fully comprehended.

AUSTRALIAN WAGES.

According to the "Australian Mining Standard," a wages board has lately been dealing in Sydney with the conditions of labour of electrical workers employed by the Railways and Tramways Department, and by the City Council. In the case of the railways and tramways the board fixed the wages of electrical mechanics at 9s. 6d. per day, electrical fitters 11s., and leading hands 12s. By another award it fixed the wages of electrical fitters employed by the City Council at 11s. 4d., of mechanics at 12s., and of cable jointers at 11s. 4d., with leading hands 1s. additional. The wages of other employees are 7s. 6d. to 8s. 6d.

London Agents.

Messrs. Tetley & Company, of Manchester, have appointed Messrs. Feld Brothers & Company, Ltd., 25, Budge Row, London, E.C., as their sole agents for London and South of England for all their manufactures.

"THERE IS SOMETHING ROTTEN IN THE STATE——."

By H. Ambrose Carney.

The Institution of Electrical Engineers is about to make a certain code of professional etiquette binding upon its members. There is room in the "trade," too, for some powerful organisation which could impose even a code of common honesty upon unscrupulous traders.

There is a particularly reprehensible practice, in certain electrical circles, against which opinion should be strongly expressed. Some "engineers" when they want a piece of work doing, or some apparatus making, go to a firm with whom they deal—in enquiries principally—and get prices and also drawings. The drawings are then taken or sent to one or more other firms, and by a combination of bluff, dishonesty, incompetency, and greed, the buyer gets his material at an impossibly low price from one of the last-mentioned firms.

An entirely fabulous example will make this clearer.

The engineer or contractor X requires, for instance, a large power board for a works. He specifies what the board has to do and sends his enquiry to some firm, Y, to whom he has, perhaps, at one time or another given a small order, and whom he knows to be a maker of good, reliable material. He insists upon receiving a detailed drawing, with all dimensions and particulars, "so that he will know exactly what is proposed and quoted for, you know." The enquiry is tempting in itself, and refusal to send a drawing, or to quote, might stop further enquiries or lose the problematic custom of X. So at some little expense, probably £2 to £3, the firm design the board, make a drawing, and give a very carefully estimated and reasonable quotation to get the order. X receives the drawing from Y, who quote a price of, say, £100 for doing the work. X then goes to some other firm, taking the drawing received from Y. As the drawing is fully dimensioned and detailed, this firm is able to give a price hurriedly while X waits, and quotes, say, £95. X looks horrified, and exclaims "Why, I've already had a price of £90, and I think *that's* too high." After some further argument this firm agree to do the work for, say, £89, and quote accordingly. X either places the order at this, or, more likely, encouraged by his reduction of £11, goes to another firm—very often a little one-horse concern—and, by repeating the process, eventually gets his material from Z for, say, £75—a figure that just about covers the cost of material and very cheap labour, allowing no profits or expenses. Only by a combination of bluff on the part of X, and flurried, inaccurate estimating on the part of the firms—and of Z in particular—quoting to Y's drawing, together with an universal greed—gluttonous, or, more likely, necessitous—for orders, is such "keen" buying as I have described possible.

The firm Y, who went to the trouble of getting the drawing out and designing a very cheap but sound arrangement, are surprised they do not receive the order as they gave almost a cut price which would leave very little profit. X, however, is very sorry, but his "clients" or customers are not going on with the work, and so the board will not be wanted. He does not say that, after hawking Y's drawing round, he gave the order, for £75, to Z, who made no drawings, and possibly could not have done so to save his life.

It very often happens, however, that Y receives an order for some of the parts from Z—who, of course, does not know he is working to Y's drawing—and, recognising dimensions or details, makes diplomatic enquiries, as the result of which Y learns of X's perfidy. Rarely does Y acquaint X of this, but, grinning, nurses his anger in his own breast—such is the fear in the trade of the contractor and quack consultant. He takes care, however, in future dealings with X not to give away more than can be helped before having the order safe in the shops.

If X is so dishonourable in his dealings with the manufacturers, is he likely to be any less so with his "clients"—as he likes to call them? I do not think so. In fact, I have a strong suspicion that X pays £75 and charges £100 to his client, showing Y's tender, if necessary, and I should not be surprised to hear that the poor client also

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pays X £10 10s. for his trouble and time in designing the board—work that Y, of course, did, unpaid, hoping to get the order.

I have not made it clear whether X calls himself a "consulting electrical engineer" or a "contractor." He is usually of the "partly in and partly out" type, and his self-conferred titles do not alter the fact. There is not a very large number of examples of the X type, but those that do exist should be exposed and driven out of business. They are the cause of a good deal of needless cutting, as the above fable shows, and the method they work on deliberately encourages cutting, and the permanent lowering of prices to a ruinous level. It is by no means clear that the customer benefits by this cutting, but, even if he did, X is of his own accord choosing the dishonourable way of getting low prices where honourable means are available, and for this reason alone he should be cut out. At the prices which the X type pay for work the firm in Z's position above would be very much better off without such orders—even if no actual loss results; why work for nothing? Why not spend the time outside getting a profitable order?

It is surprising to me that strong steps have not been taken before now in this matter. No doubt the difficulty exists in many firms being still outside the associations for protecting their interests—firms outside should remember that united they stand, divided they fall. Under these circumstances, if firms inside took joint action, firms outside would probably accept the orders that the others refused, and so matters would be no better.

Much could be done, however, to lessen the evil by a little attention on the part of firms making drawings, and those asked to quote, to drawings. For instance, if firms supplying drawings *always* made a practice of printing their names in such a way that erasure would be immediately noticeable, *over* the face of the drawing itself—in much the same way as the name of a country is written on a map—and not in a corner where it could be cut off, it would be impossible for some unscrupulous X to take that same drawing to another man without this man knowing what had happened and acting accordingly. Before he could go pricing X would then have to make a tracing or another drawing, the fact or the trouble of which might deter him to some extent. Tracings should always be looked upon with suspicion, as should sketches and drawings which do not give sufficient details from which to derive the dimensions which are given. They may be genuine, but they may not. Much of this smart buying would disappear if only firms, and especially the very little firms, receiving such particulars to quote to would estimate carefully and in detail before quoting, and then stand by their own judgment and not allow themselves to be beaten down by a man who takes the trouble to come round and say he can buy cheaper elsewhere. They ought to remember that it is the practice to buy in the cheapest market without apology to the unsuccessful tenderers, who invariably, with men of the X type, have to call to find out the result.

There is no question of friendship in the mind of an X when he goes to the little man to say he can buy somewhere else £10 cheaper at a big man's. Any such statements should immediately arouse the little man's suspicions and make him very chary of giving any reduction whatever. In quoting fairly, the little man should always remember that for such specified work he has always a rather better chance of giving a low price than the big man because in that case shop orgainsation and good buying of raw material do not reduce the cost much, but the higher establishment charges of the big man do increase the price a good deal. If the big man's employees have given a careless quotation, and thereby are going to lose money on the order, why should the little man rush in against his own better judgment and accept the order at a price he thinks impossibly low, just because X tells him someone else quoted that price?

A still better plan for dealing with X's, and one adopted by some firms who have been taken in by these specimens, is to refuse to supply drawings at all except after receiving the order. This, however, not being universally accepted as a trade custom, very often causes the firms to lose orders from honest men, who imagine that they have been suspected, though as a matter of fact they have not been, the rule being merely inflexible.

Would it not be a good thing for all the firms—large and small—in all branches of the electrical manufacturing business to agree to send no drawings whatever—beyond such things as catalogue illustrations and the like—until the order is placed? All that is needed is for signatures to be collected to some such resolution as the following:—

"That from ..... next we, the undersigned firms, agree not to send out any drawings, other than catalogue illustrations and the like, to any customer or prospective customer whatsoever, until the order for the work, to which the drawings relate, is in the hands of the firm concerned."

It would, of course, have to be clearly defined what might be sent and what not. The names of the signatories and the resolution could be advertised in all the electrical papers. After the date agreed upon the withholding of drawings being a recognised trade custom, all trouble would vanish, except such as recanters or firms foolishly holding aloof might bring upon themselves. Some further resolutions, though quite independent of the above, might refer to such matters as quoting to sketches, drawings, etc.; the disclosing to the other signatories of the names of men who attempt to trade in the dishonourable way referred to above, with a view to the universal refusal to sell to them.

Such a proposal as this last may sound very drastic in operation, but the fact that such a thing could happen would have a most salutary effect on the commercial morality of the electrical trade.

No elaborate or expensive organisation is needed to collect these signatures or to frame these resolutions. The electrical papers which have already done so much for the business would, I am sure, gladly open their columns to discuss the matter and decide on the wording of the resolution or resolutions. Consultants—that is, the real thing, and contractors, could also state their views if this was thought desirable.

After discussion the resolution could then be printed in its most acceptable form in the papers and an officially-signed postcard sent in to the editor—if he was agreeable to this—or to some other disinterested person, agreeing to the resolution, from each firm who did agree with the principle and wished to adopt the idea, would be all that would be necessary. After, say, two weeks, the resolutions and a list of all the firms agreeing to them—by postcard—could be printed in the paper; this to be taken as publicly binding on the firms. Thus the good custom of keeping drawings back could be followed without giving offence to even the most dignified ornament of the engineering profession. And, further, a good understanding on this point, come to by this simple means, might pave the way to the introduction of other equally desirable trade customs later on.

PUBLICATIONS.

"Commercial Year Book of the Leeds Incorporated Chamber of Commerce." Edited by R. K. Calvert. (London and Leeds: Bemrose & Sons, Ltd.).

This book, which contains a classified trade index of the members of the Chamber, has been compiled by the Secretary with the double object of providing traders in all parts of the world with an idea of Leeds industries, and of giving information to members concerning regulations of Colonial and Foreign Governments relating to British merchandise and trading.

"Universal Directory of Railway Officials, 1910." By S. R. Blunderstone. (London: The Directory Publishing Company, Ltd. Price, 10s.).

For the 16th year in succession this useful publication has made its appearance. It is divided into three main sections: an index to names of railways, tramways and railway institutions; railway and tramway undertakings with names of officials and certain technical details as to length and gauge of line, system of electrification (if any), arranged alphabetically and classified according to countries; and a personal index of railway and tramway officials.

Time Measuring and Indicating.

Another step towards a European universal electric time recording standard has been taken. France now proposes to fall in with Belgium, Holland, Luxemburg and Spain in adopting the Greenwich meridian for standardising time.

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THE IMPROVING POSITION.

A more cheerful tone pervades the electrical industry, and justifiably so, for there is an all-round improvement, with every sign that the improvement will persist and grow. Engineers are busy and looking forward with reasonable optimism to a steady revival in big installation schemes. No less than 25 applications for Provisional Orders under the Electric Lighting Acts have been made to the Board of Trade, 19 of which have been granted subject to Parliamentary sanction. This is an increase of close upon 50% on last year. Beside this, reports come in from many towns that the local authorities have decided to apply for Provisional Orders. Even more significant are the numerous cases where individuals and companies are preparing to instal electric supply stations, or seeking powers to do so, without appealing to Parliament, and merely with the consent of the local authorities. Side by side with all this is the great increase taking place in the partial or total electrification of works of every description. When the consulting and central station engineers are busy, the manufacturers quickly feel the benefit. That this influence has made itself felt is evidenced by the renewed activity in works all over the country, and also very agreeably in several of the annual reports of our large engineering firms. In spite of one or two gloomy instances, where directors have had to come empty-handed to their shareholders and report contracts carried out at a loss or at barely paying rates, larger turnovers and better profits are becoming more and more the rule. Instances can easily be found. Take the case of the Aron Meter Company, whose directors recently had so cheerful a report to place before their shareholders. The Electric and General Investment Company have had two years of growing profits, and are doing even better this year. If the Electric Construction Company had to face a reduction in gross profits, it is, nevertheless, the case that at least one of their subsidiaries, the Electrical Power Storage Company, has done better, although the directors deemed it advisable to carry forward the profits. Then we have the very notable example of the General Electric, with an increased profit of £17,000 (£95,000 as against £78,000 for the previous year), and the splendid tale of activity at its different

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IMPORTANT NOTICE.

"SIRIUS-KOLLOID" TUNGSTEN LAMPS

WILL, IN FUTURE, BE SOLD UNDER THE NAME OF

Brimsdown

PATENT

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METALLIC FILAMENT LAMPS.

BRITISH MANUFACTURE.

DELIVERY FROM STOCK.

Telephone: Gerrard 1728.
Telegrams: "Bulbolite, London."

Head Office and Works:
BRIMSDOWN, M'SEX.

Imperial Lamp Works (Brimsdown) Ltd.,
SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

works; the successful competition in the manufacture of carbons, especially those for the flaming arc lamp; the building up of a prosperous, extremely busy industry of telephone equipments, so busy, indeed, as to necessitate the erection of new works and the formation of a subsidiary company to run them. Up North, the big electrical engineering companies have their hands pretty full of work, and so far as can be ascertained, at fairly good prices. We do hear complaints that business in certain accessories, certain classes of minor work and installations, can only be secured at little better than cut prices. But after a spell of slack time it is only natural that supply should at first be rather greater than demand, with the result of rather too keen competition. This will right itself, when the improvement has had time to spread to every phase of the electrical industry and every section of the business world. No doubt there is still hard fighting before us. Victory will be for the well equipped, the persevering and enterprising.

FINANCIAL NOTES.

MONTREAL LIGHT, HEAT AND POWER.—The Bank of Montreal have been instructed to make the following notification: The directors of the Montreal Light, Heat, and Power Company have declared a dividend of 1¾% on the paid-up capital stock (being at the rate of 7% per annum) for the quarter to the 31st inst.; first, to shareholders of record on the 31st inst. on the Montreal and London (England) registers; secondly, to holders of share warrants in redemption of coupon serial No. 37. Dividend cheques will be mailed to registered shareholders on the 15th proximo and share-warrant coupons will be redeemed on presentation at the company's offices in Montreal, or at the banking-house of Messrs. L. J. Forget & Company, 8, Rue Auber, Paris.

* * *

ST. JAMES AND PALL MALL ELECTRIC LIGHT.—The following interim dividends for the half-year ended June 30, 1910, have been declared: At the rate of 7% per annum on the Preference shares and at the rate of 10% per annum on the Ordinary shares.

* * *

KENSINGTON AND KNIGHTSBRIDGE ELECTRIC.—The directors have declared an interim dividend on the ordinary shares for the half-year ended June 30, 1910, at the rate of 8% per annum, payable August 15.

* * *

ANGLO-AMERICAN TELEGRAPH.—The total receipts from January 1 to the 30th ult., including the balance brought forward, amounted to £208,949. The traffic receipts show an increase of £6,988 as compared with the half-year ended June 30, 1909. The working expenses amounted to £75,652, being an increase of £3,307 as compared with the corresponding period. The directors have, before declaring the net profits, set apart the sum of £10,000 to the renewal fund, leaving a balance of £123,297. Quarterly interim dividends of 15s.% on the Ordinary stock and £1 10s.% on the Preferred stock, were paid on April 30 last, and second quarterly interim dividends of 15s.% on the Ordinary stock and £1 10s.% on the Preferred stock will be paid on the 30th inst. The balance of £18,297 will be carried forward.

* * *

BRISTOL TRAMWAYS AND CARRIAGE.—At a meeting of the directors held at the offices of the company, under the presidency of Sir George White, Bart., an interim dividend was declared at the rate of 4% per annum for the half-year ended June 30. The dividend warrants will be posted to the shareholders on Friday, the 29th instant.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 168, Fleet Street, London, E.C.

CONTRACTS.

CITY OF MANCHESTER.

ELECTRICITY DEPARTMENT.

The ELECTRICITY COMMITTEE of the Manchester Corporation are prepared to RECEIVE TENDERS for the supply, delivery, and erection at their Bloom-street Generating Station of an INDUCED DRAUGHT PLANT.

Specifications, drawings, and forms of tender may be obtained on application to Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall, Manchester.

Further particulars and information can be obtained from Mr. S. L. Pearce, Chief Electrical Engineer, Dickinson-street, Manchester.

Tenders, duly endorsed, and addressed to the Chairman of the Electricity Committee, must be delivered at the Town Hall not later than noon on Tuesday, the 2nd August proximo.

The Corporation do not bind themselves to accept the lowest or any tender.

THOMAS HUDSON, Town Clerk.

Town Hall, Manchester,
July 19, 1910.

ROYAL HOSPITAL FOR INCURABLES. DONNYBROOK.

ELECTRIC LIGHTING.

The Governors of this Hospital are prepared to receive Tenders for the Electric Lighting of the Institution, in accordance with plans and specification prepared by Mr. P. Tomlinson, M.I.E.E., 16, Beresford-place, Dublin, from whom copies may be obtained on payment of £1 1s., which will be returned on deposit of copies and a *bona fide* Tender.

Sealed Tenders to be submitted by 12 o'clock on Tuesday, August 2, 1910, marked on the outside "Tender for Electric Lighting," and addressed to the undersigned.

The lowest or any Tender not necessarily accepted.

By Order,

JOHN J. THOMPSON, Registrar.

APPOINTMENTS.

NORTHAMPTON POLYTECHNIC INSTITUTE, ST. JOHN-STREET, LONDON, E.C.

The governing body invite applications for the following appointments, to take effect after the coming vacation:

ELECTRICAL ENGINEERINC DEPARTMENT.

SENIOR ASSISTANT to take charge of new Electric Generating Station. Full time. Knowledge of gas engines and of both continuous and alternating current machines and switchboards essential. Salary 45s. per week.

JUNIOR ASSISTANT for the above; chiefly to take charge of the Power Plant. Full time. Should have had experience in Central Station work. Salary 28s. per week.

SECOND LECTURE ASSISTANT. Full time. Salary £80 per annum.

MECHANICAL ENGINEERING DEPARTMENT.

ASSISTANT LECTURER AND DEMONSTRATOR. Full time. Salary £120 per annum.

Further particulars of the conditions of any of the above appointments can be had on application at the offices of the Institute, or of the undersigned; but applicants writing for particulars are requested to be careful to specify for which vacancy particulars are desired. All applications are required to be in at an early date.

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

CONTRACTS OPEN.

HOME.

CHELMSFORD.—Borough Education Committee invite alternative tenders for (1) supplying and fixing wiring for lighting by electricity; (2) supplying and fixing pipes for lighting by gas, at the Trinity-road Council School. Particulars from Mr. W. H. Pertwee, architect, The Institute, London-road, Chelmsford. August 31.

DONNYBROOK.—The Governors of the Royal Hospital for Incurables invite tenders for the electric lighting of the Institution. Particulars from Mr. P. Tomlinson, M.I.E.E., 16, Beresford-place, Dublin. August 2.

LONDON.—The Secretary of State for India in Council is prepared to receive tenders from such persons as may be willing to supply: (1) Overhead floating staging; (2) electrically-driven water supply pumps. Particulars from the Director-General of Stores, India Office, Whitehall, S.W. August 3.

LONDON, S.W.—London County Council.—Wiring and fitting second section of Woolwich-road car repair depot. (Specifications £2, County Hall, Spring Gardens, S.W.) August 22.

MANCHESTER.—Corporation invite tenders for the supply and erection of an induced draught plant. Particulars from the Secretary, Electricity Department, Town Hall. August 2.

NEWPORT.—Corporation.—Annual supply of carbon filament electric lamps (British made), radiator lamps (British made), flame arc carbons for Excello and Oliver types of lamps, alternating and direct current two-rate and prepayment meters. (Specifications, 10s., to Borough Treasurer, Borough Electrical Engineer and Tramways Manager). August 15.

SOUTH SHIELDS.—Corporation Tramways.—One 5-ton hand-operated travelling crane for tramways depot. (Particulars from Manager and Engineer, Dean-road.) August 8.

OVERSEAS.

BRISBANE.—Battery material, stores, chemicals. September 7.

BRISBANE.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up to noon on September 7, for the supply of (1) glass cells, corks and tubes, and porous cups for batteries (Schedule No. 120), and (2) battery material, chemicals, etc. (Schedule No. 121). A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications, etc., may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

CAIRO.—Department of the Interior.—Electric lighting plant for Assiut. Particulars from Secretary. July 30.

COPENHAGEN.—For the supply of electricity meters to the Copenhagen Lighting Department, tenders, marked "Tilbud paa Maalere," must reach "Direktören for Belysningsvæsenet, Raadhuset," Copenhagen, by noon on August 2. Copies of the specifications, &c. (in Danish), from the Secretary, or may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

LORENZO MARQUES.—Harbour and Railways Board.—One 10-ton and 75-ton electric cranes. (Particulars, 9 milreis gold, General Stores, Harbour and Railway Board, Lorenzo Marques, or Agency of Caminhos de Ferro de Lorenzo Marques, Johannesburg, or Direcgao dos Caminhos de Ferro Ultramarinos, Lisbon.) English translation, 4·5 milreis gold, from Caixa Geral dos Depositos, Lisbon, or from the Johannesburg or Lorenzo Marques authorities above indicated.) September 5.

MOSTAR.—Municipality.—Electricity works. (Particulars from Chief Magistrate.) October 1.

ST. PETERSBURG.—Municipality.—Commutator switchboard tables for telephone exchange extension. (Particulars from Telephone station, Morskaja, 22.) August 15.

WELLINGTON, N.Z.—Minister of Telegraphs.—Installations of wireless telegraphy at or near (1) Doubtless Bay, (2) Gisborne, (3) Cape Farewell, (4) Sumner, near Christchurch, and (5)

OSRAM LAMPS

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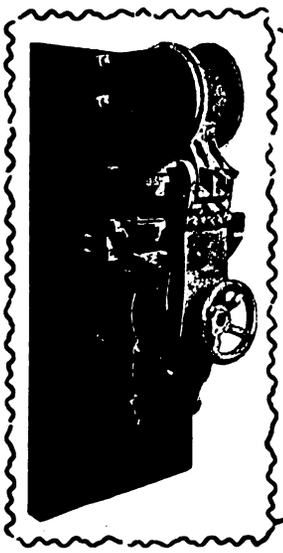

Really Reliable Remote Control

is pos-ible only when the controlling switch is wholly independent of mechanical devices for circuit making and breaking—and when it is so constructed that the operator cannot possibly make mistakes - as with the

ADAMS IGRANIC
CLAPPER & CONTACTOR SWITCH.

APPOINTMENTS.—continued.

TAUNTON CORPORATION.

ELECTRICAL UNDERTAKING.

APPOINTMENT OF BOROUGH ELECTRICAL ENGINEER.

The Town Council of Taunton invite applications from qualified Engineers for the above appointment. Salary commencing at £200 per annum and half pupils' premiums.

The Engineer appointed must devote the whole of his time to the service of the Corporation and reside in the Borough.

The Engineer will be required to take entire charge of the business of the undertaking and be responsible for the undertaking and the plant.

The system is "High Tension Single-Phase" and "Traction," and applicants must have had experience of similar systems.

Applications, in Candidates' own handwriting, stating age and experience, accompanied by not more than three copies of recent testimonials (which will not be returned), endorsed "Borough Electrical Engineer," to be received by me not later than 9 a.m. on Thursday, August 4, 1910. Forms of applications are not supplied.

Personal canvassing will disqualify.

GEORGE H. KITE,
Town Clerk.

Municipal-buildings, Taunton.
July 25, 1910.

UNIVERSITY OF BIRMINGHAM.

ASSISTANT LECTURER AND DEMONSTRATOR IN ELECTRICAL ENGINEERING.

The Council invite applications for the above appointment.

Candidates must be Graduates, and must have had at least one year's employment in a responsible position in the test room of a first-class electrical engineering firm. Candidates with experience in lecturing will be preferred. The successful candidate will be required to superintend the students' work in the electrical engineering laboratories, and to assist the professor in tutorial classes.

Stipend £150 per annum.

Applicants should state age, training, and previous experience, and should send in their applications, accompanied by copies of testimonials (not originals) on or before September 17, 1910, to the undersigned, from whom further particulars may be obtained.

The appointment and stipend will date from the 1st October next.

GEO. H. MORLEY, Secretary.

SUB-STATION ATTENDANT.

Applications are invited for the post of Sub-station Attendant. Applicants must have had experience with high-tension three-phase A.C. switchgear, converting plant, and low-tension three-wire D.C. supply. Salary to commence 30s. per week. The successful applicant will be required to reside within the Borough of Stepney.

Applications, stating age, experience, and accompanied by not more than three recent testimonials, to be addressed to Engineer and Manager, No. 27, Osborn-street, Whitechapel, E.

July 20, 1910.

ESTABLISHED FIRM of ELECTRICAL CONTRACTORS in provincial town contemplating opening a branch in Manchester or purchasing small established Electrical Business there, wish to enter into negotiations with a young, energetic man as REPRESENTATIVE. Applicants must have practical experience in the business and, preference would be given to one having a thorough knowledge of estimating and possessing a local connection among Consulting Engineers, Architects, and principal business houses.—Apply, stating age, experience and remuneration required, Box 80, c/o. THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

Bluff. A deposit will be required with each tender. (L.) (Specifications, High Commissioner for New Zealand, 13, Victoria-street, S.W.) December 15.

TENDERS ACCEPTED—Home.

LONDON:—County Council.—Installation of electric lighting at certain schools. Central Motor Engineering Company, 79A, Parkhurst-road, Kensington, N., £175 12s. 6d.; St. Pancras' W., £240 14s. 6d.

LONDON:—County Council.—Supply of electrically-driven motor (escape) vans. "Cedes" Electric Traction, Ltd., 14 and 15, Cockspur-street, S.W. If one is ordered, £1,298 11s. 9d.; if three are ordered, £1,044 18s. 11d.

LONDON:—County Council.—Supply of 250 cars, etc., for London County Council Tramways. (1) Car bodies. The Brush Electrical Engineering Company, Ltd., Loughborough, £94,375. (2) Car trucks. Heenan & Froude, Ltd., Worcester, £28,750. (3) Electrical equipment and assembly of cars. The British Westinghouse Electric and Manufacturing Company, Ltd., Strand, W.C., £83,812 10s. (4) Supply of 250 sets of magnetic brake equipments. British Westinghouse Electric and Manufacturing Company, Ltd., £14,250.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ALFORD: R. H. Fowler, architect, Louth. Erection of Territorial Headquarters.

CRICKHOWELL: E. A. Johnson, architect, Abergavenny. Erection of garage, etc.

DURHAM: G. H. Fowler, architect, The College, Durham. Erection of district church at Usher Moor, near Durham.

HALIFAX: C. Williams & Sons, architects, Commercial-street, Halifax. Arcade, billiard hall, etc.

KINGSTOWN, IRELAND: Urban Council. Carnegie Library.

LISKEARD: J. Sansom, architect. Rebuilding of Constitutional Club.

MACCLESFIELD: Clerk to the Grammar School Governors, King Edward's-street, Macclesfield. New school for 200 boys.

PORT TALBOT: A chapel is to be erected at a cost of £4,000.

STIRCHLEY: J. P. Osborne, architect; E. Crowder, builder. Public Swimming Baths for King's Norton and Northfield Urban Council. Cost £10,000.

SWANSEA: Education Committee, Grove-place, Swansea. Erection of Training College for Women.

TWICKENHAM: F. W. Pearce, Surveyor to Council. School buildings,

BUSINESS WANTED.

WANTED, a well-connected, sound, established BUSINESS, or a PARTNERSHIP would be considered.—Box No. 26, c/o ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

ESTABLISHED FIRM of ELECTRICAL CONTRACTORS in provincial town desires to PURCHASE, as a going concern, small established Electrical Contracting Business in Manchester, with good-class connection and capable of development.—Apply, Box 85, c/o. THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

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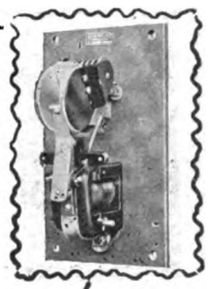
THE ADAMS 'IGRANIC'

CLAPPER AND CONTACTOR SWITCH



which operates electrically throughout and can be placed in any position. It has no "puzzle" features to be solved by the attendant; and it is perfectly safe—the fiercest arc is powerless against the efficient blow-out fitted. You cannot afford to be without it.

Let us send you full Particulars.

Adams Manufacturing Co., Ltd., 106, New Bond Street, London, W.

Works—BEDFORD.

TENDERS.

PLANT FOR SALE.

The Corporation of Dewsbury invite Tenders for one steam engine with two dynamos coupled to it.

The engine is of Messrs. Willans & Robinson's make, 2 F compound 450 r.p.m., and built for 150 lbs. pressure at the stop valve.

The dynamos are 15 kilowatts each of Messrs. Crompton & Co.'s make, and work at a D.C. pressure of 220 to 250 volts; also the switchboard panel and resistances are included in the sale.

This set can be seen running, and further particulars obtained from the undersigned.

Offers to be sent to the Chairman, Electricity and Tramways Committee, 93, Bradford-road, Dewsbury.

R. H. CAMPION, Borough Electrical Engineer.

PATENTS.

3. SOKAL, Chartered Patent Agent,

AND

Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.

55, CHANCERY LANE, LONDON, W.C.

THE PROPRIETOR OF THE PATENT NO. 18408 of 1906, for "Improvements in Electric Insulators for High Tension Conductors," is desirous of entering into arrangements by way of licence and otherwise, on reasonable terms, for the purpose of exploiting the same and insuring its full development and practical working in this country. All communications should be addressed, in the first instance, to—

HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
7 & 8, Southampton-buildings, Chancery-lane, London, W.C.

TO MANUFACTURERS OF ELECTRICAL ACCESSORIES AND OTHERS.

THE PROPRIETOR OF PATENT NO. 10457 of 1906, for "Process of Manufacturing Electric Coils," is desirous of entering into negotiations for the Sale of the Patent or for the grant of Licenses to manufacture under same.

Full particulars can be obtained from—

GEORGE BARKER,
Chartered Patent Agent, 77, Colmore Row, Birmingham.

PLANT FOR SALE.

Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

PLANT WANTED.

PLATINUM UTENSILS, SCRAP, LAMP TOPS.—Best prices given by DERBY AND Co., LTD., 44, Clerkenwell-road, London, E.C. N.B.—Platinum Sold.

AGENCIES.

LIBERAL COMMISSION is offered to an energetic and capable salesman calling upon users of nuts and bolts, to introduce a Patent that will save all users 75 per cent.—Address, B.C., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

SITUATIONS VACANT.

APPLICATIONS for Appointments effectively arranged, ensuring favourable consideration. Numerous unsolicited testimonials. Expert advice. Write now.—HERBERT GREATOREX, Beechwood, Matlock.

MEN OUT OF EMPLOYMENT in all branches of the Electrical Trade should write to Box No. 20, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

JUNIOR SUB-STATION ATTENDANTS WANTED by three-phase London Railway; preference given to students of Polytechnic, Northampton and other Institutes. State age, experience and salary required, to Box 21, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WANTED, STOREKEEPER, accustomed to Electric Tramway, Lighting and Wiring Material and pricing of same. Salary 30s. per week. Only experienced man and good book-keeper need apply.—Box 22, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

WANTED, Competent Electrical Engineer Draughtsman, thoroughly conversant with Motor Car Construction. Give experience, references and salary required. Box No. 52, c o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

SITUATIONS WANTED.

ELECTRICAL GRADUATE of an American University, with 1½ year's practical training with the largest Electrical Company at present in America, desires position with some Technical Institution or in Electrical Laboratory. Can furnish excellent references both in England and America.—Address, Box N.Y., c/o THE ELECTRICAL ENGINEER.

MANUFACTURER'S REPRESENTATIVE desires change; London or Provinces.—Box A., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

MOTORMAN, excellent references, 5 years' experience with St. Helens Tramway Company.—Box S., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WIREMAN, 5 years' experience; age 25.—Box T., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, aged 16, seeks engagement, Electrical Engineer. North London preferred. Intelligent, good education.—R. C., ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

ELECTRICAL MAINS FOREMAN, thoroughly acquainted with all branches of the work, both high and low tension cables laid on all systems; also knowledge of overhead and construction and permanent way. Excellent references.—G. P., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

ELECTRICIAN, 24, seeks re-engagement. Town or country. Six years' good all-round experience; good references. 46, Hill-street, Peckham.

MISCELLANEOUS.

CLEANERS and BLEACHERS of Meat Cloths for Engineers' and Garage use, sold in 7 lbs. bundles at 3/6, cash with orders. Carriage forward.—A. & T. INGERSOLL, 62, Waterloo-street, Camberwell, London, S.E.

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TECHNICAL CLASSES.

City and Guilds of London Institute.

ENGINEERING AND CHEMISTRY.

There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE.

(EXHIBITION ROAD, S.W.)

A College for higher Technical Instruction for Day Students not under 16 preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a "*School of the University of London*," and also forms the *Engineering Section of the Imperial College of Science and Technology*. The Entrance Examination includes the subjects of Mathematics, Mechanical Drawing, Physics, Chemistry, English Composition, and French or German Translation, and the Courses of Study for the Associateship of the Institute cover a period of three years. Fees, £36 per Session. Professors :—

Civil and Mechanical Engineering ..	W. E. DALBY, M.A., B Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering	T. MATHER, Wh. Sch., F.R.S.
Chemistry	H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics ..	O. HENRICI, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY.

(LEONARD STREET, CITY ROAD, E.C.)

A College for Day Students preparing to enter Engineering and Chemical Industries, and for those who have already served an apprenticeship, and also for Evening Students. The subjects of the Entrance Examination are Mathematics, and English Composition and Precis Writing. The Day Courses in Mechanical or Electrical Engineering cover a period of two years, and those in Chemistry three years. Fees, £20 per Session. Professors :—

Physics and Electrical Engineering	SILVANUS P. THOMPSON, D.Sc. F.R.S., Prin. of the College
Mechanical Engineering and Mathematics ..	E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry	R. MELDOLA, F.R.S., F.I.C.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C.

King's College, London.

UNIVERSITY OF LONDON.

FACULTY OF ENGINEERING.

Complete COURSES OF STUDY, extending over either three or four years, are arranged in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London, and for the Diploma and Certificate of the College.

The four years' course provides, in addition to the Academic Training, opportunity for practical training in "Works."

Special courses of ADVANCED LECTURES are to be given on "Internal Combustion Engines," and the "Theory and Practice of Construction."

ENTRANCE DAY FOR NEW STUDENTS, TUESDAY, OCTOBER 4.

HEADS OF DEPARTMENTS.

Engineering ..	Professor D. S. CAPPER, M.A., M.Inst.C.E. (Dean).
	Professor H. M. WAYNFORTH, M.I.M.E., A.M.Inst.C.E. (Sub-Dean).
	Professor M. CURRY, M.Inst.C.E.
Electrical Engineering	Professor E. WILSON, M.I.E.E.
Mathematics ..	Professor S. A. F. WHITE, M.A.
Chemistry ..	Professor J. M. THOMSON, F.R.S.
Physics ..	Professor C. E. BARKLA, D.Sc.
Metallurgy ..	Professor A. K. HUNTINGTON, M.I.M.M.
Geology ..	Mr. T. F. SIBLY, D.Sc.

For full information and prospectus apply to the DEAN or to the SECRETARY, King's College, Strand.

University of London, University College.

PROVOST .. T. GREGORY FOSTER, Ph.D.

SESSION 1910-11.

FACULTY OF ENGINEERING.

The Session begins on MONDAY, OCTOBER 3rd.

Mechanical Engineering ..	J. D. CORMACK, D.Sc., M.I.M.E. (Vice-Dean)
Electrical Engineering ..	J. A. FLEMING, M.A., D.Sc., F.R.S. (Dean)
Electrical Design	H. M. HOBART, M.I.G.E.
Civil Engineering	H. DEANS, M.I.C.E. (Railway Engineering)
	A. T. WALMISLEY, M.I.C.E. (Waterways, Harbours and Docks)
	W. M. BLAIR, M.I.C.E. (Roads, Street Paving, Tramways)
Municipal Engineering ..	OSBERT CHADWICK, M.I.C.E., M.I.M.E., C.M.G.
	R. E. MIDDLETON, M.I.C.E.
Surveying	M. T. ORMSBY, M.I.C.E.I.
	E. SPRAGUE, A.M.I.C.E.
Physics	F. T. TROUTON, M.A., F.R.S.
General and Physical Chemistry	Sir WILLIAM RAMSAY, K.C.B., F.R.S.
	N. T. M. WILSMORE, D.Sc.
Applied Mathematics ..	KARL PEARSON, M.A., F.R.S.
Economic Geology	E. J. GARWOOD, M.A.
Mathematics	M. J. M. HILL, M.A., Sc.D., F.R.S.
Hygiene and Public Health	H. R. KENWOOD, M.B., D.P.H., F.C.S., F.R.S.E.

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Students desirous of entering the Faculty of Engineering with the view of taking a full Degree or Diploma Course must have passed the Matriculation Examination, or some other examination accepted in its stead.

Fee for the full three-year Diploma Course in Engineering, including the Course for Graduation (B.Sc.) in the Faculty of Engineering, 120 Guineas (payable in three instalments of 45, 40 and 35 Guineas).

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Students who have already undergone a partial training elsewhere, and who have attained a sufficient standard, may enter for a Course occupying less than three years, and may obtain a General Certificate of Engineering after not less than two consecutive sessions.

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Graduates in Science or Engineering or Students who have done the work equivalent to a degree, may be admitted to Special Courses of Study, or to prosecute original research.

ADMISSION.

Intending Students should communicate with the Provost as soon as possible, and in any case not later than SEPTEMBER 20th, and should send a full statement of their previous training.

Full particulars may be obtained on application to the undersigned.

WALTER W. SETON, M.A., *Secretary*,
University College, London
(Gower Street).

University of Glasgow.

DEPARTMENTS OF ENGINEERING, MINING AND NAVAL ARCHITECTURE.

PROFESSOR OF ENGINEERING	Archibald Barr, D.Sc., M. Inst.C.E., M.I.Mech.E.
PROFESSOR OF NAVAL ARCHITECTURE	J. Harvard Biles, LL.D., D.Sc., M.I.N.A., M.Inst.C.E.
PROFESSOR OF MINING	Charles Latham, M.I.M.E.
LECTURER ON ENGINEERING DRAWING AND DESIGN	Harry Bamford, M.Sc., A.M.Inst.C.E.
LECTURER ON ELECTRICAL ENGINEERING	John S. Nicholson, B.Sc., Whit.Sch. A.M.I.E.E.

The SESSION commences on October 17th, 1910, and ends on March 23rd, 1911. Students usually spend the summer months in practical work, thus receiving their training on the Sandwich system.

Prospectus of the Courses for the degrees of B.Sc. and D.Sc. in Engineering and Syllabus of Classes will be forwarded on application to the

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Matriculation Office,
The University, Glasgow.

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Northampton Polytechnic Institute,

Clerkenwell, London, E.C.

ENGINEERING AND TECHNICAL OPTICS.

MECHANICAL AND ELECTRICAL ENGINEERING AND ELECTRO-CHEMISTRY.

Full Day Courses in the Theory and Practice of the above Subjects will commence on MONDAY, OCTOBER 3, 1910. The courses in Mechanical Engineering include specialization in Automobile and Aeronautical Engineering, and those in Electrical Engineering include specialization in Radio-Telegraphy. ENTRANCE EXAMINATION on WEDNESDAY and THURSDAY, SEPTEMBER 28 and 29. These courses include periods spent in Commercial Workshops, and extend over four years. They also prepare for the degree of B.Sc. in Engineering at the University of London. Fees, £15 or £11 per annum.

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Full and Part Time Day Courses in all branches of this important department of Applied Science given in specially equipped laboratories and lecture rooms.

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R. MULLINEUX WALMSLEY, D.Sc.,
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University of Durham.

Armstrong College, Newcastle-upon-Tyne.

PRINCIPAL: W. H. HADOW, M.A., D.MUS.

SESSION 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

Departments of Mechanical, Marine, Civil, and Electrical Engineering, Naval Architecture, Mining, Metallurgy, Agriculture, and of Pure Science, Arts, and Letters.

Full particulars may be obtained on application to—

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Secretary.

Armstrong College,
Newcastle-upon-Tyne.

The University of Liverpool.

SESSION 1910-11 COMMENCES ON TUESDAY, OCTOBER 4.

FACULTY OF ENGINEERING.

DEAN: J. WEMYSS ANDERSON, M.INST.C.E.

PROFESSORS AND LECTURERS.

Engineering	Harrison Professor: W. H. WATKINSON, M.E., M.I.C.E., M.I.M.E., M.I.E.E. Lecturer in Strength of Materials: W. MASON, M.Sc., A.M.I.C.E.
Electrical Engineering	David Jardine Professor: E. W. MARCHANT, D.Sc., M.I.E.E.
Civil Engineering	Prof. S. W. PERROTT, M.A.I., M.I.C.E.
Naval Architecture	Prof. W. S. ABELL, R.C.N.C.ret., M.I.N.A.
Engineering Design and Drawing	Lecturer: J. WEMYSS ANDERSON, M.E., M.I.C.E., M.I.M.E.
Mathematics	Professor F. S. CAREY, M.A.
Physics	Lyon Jones Professor: L. R. WILBERFORCE, M.A.
Inorganic Chemistry	Grant Professor: E. C. C. BALY, F.R.S.
Railway Engineering	Associate Professor: J. A. F. ASPINALL, M.E., M.I.C.E., P.I.M.E.
Municipal Engineering	Associate Professor: J. A. BRODIE, M.E., M.I.C.E., M.I.M.E.
Municipal Electrical Engineering	Associate Professor: A. BROMLEY HOLMES, M.E., M.I.C.E., M.I.E.E.
Dock and Harbour Engineering	Associate Professor: ANTHONY G. LYSTER, M.I.C.E.

The Courses of Study in the Faculty leading to the ordinary degree of Bachelor of Engineering extend over at least three years. They are so arranged as to afford a general scientific training for those who intend, with or without graduating, to become engineers, naval architects, or architects and surveyors.

Students who do not proceed to a University degree may take a course of not less than two years leading to a Certificate in Engineering.

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P. HEBBLETHWAITE, M.A., Registrar.

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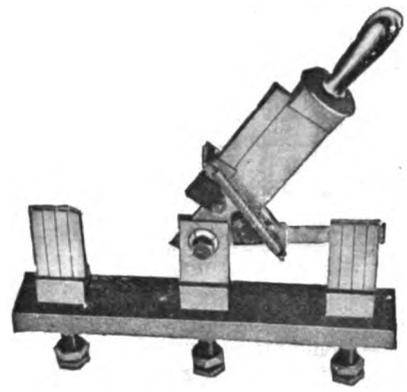
NOTES.

"Witton" Switches.

The General Electric Company, Ltd., has recently placed upon the market a complete assortment of chopper type switches—to be known as the "Witton" type—which are manufactured throughout at the Witton Works. These switches are made and stocked for max. 30, 60, 100, 200, 300, 400, 600, 800, 1,000 amps., and any larger capacities up to a max. of 10,000 amps. capacity can be made up at short notice. This is a larger range and bigger number



of sizes than can be obtained from most makers. The advantage of the many sizes is evident, if one considers that it does away with the necessity of paying for, say, a 600 amp. switch for, say, 350 amps., because the 600 amp. switch happens to be the nearest larger size. The same general design has been carried through the whole range, and the appearance of the switches of different capacities is therefore similar, an obvious advantage which will be readily appreciated by switchboard makers, as it certainly improves the appearance of a switchboard if the apparatus mounted thereon is of a uniform type. The switches are amply dimensioned, the current density nowhere exceeds 1,000 amps. per sq. in. sectional area and 60 amps. per sq. in. surface area in the contact clips. With regard to surface density, it is claimed that these switches are the most amply rated of any obtainable; this is a decided advantage, as most losses in switches are due to insufficient contact surface in the clips. Moreover, it allows of the switches being over-rated as much as 50% permanently without dangerous heating, and much higher for short periods. This may be very desirable in an emergency. The illustrations explain the design very well, and it is only necessary to point out a few details. For instance, the flipper blades, which give the quick break, are fitted with a steel stamping where they are hinged, and the main blade is bushed with a steel bush for the hinge pin, which makes the actual wearing parts very strong. At the handle end, the main blades up to, and including, 200 amps. are provided with pressed steel clips to attach the handle, or, in multipole, switches the bridge. Over 200 amps. solid

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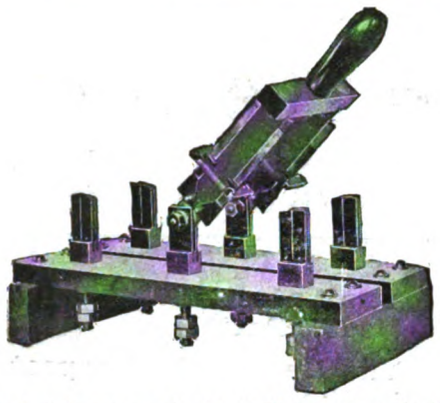


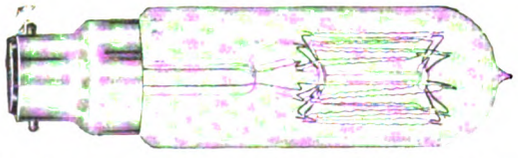
square steel ends are used. To hold the blade in the "off" position in change over switches, or where there should be no room to swing the switch right over, shaped steel springs are provided, which are fixed to the side of the hinge contact and act on the rounded end of the flipper blade pivot pin. The switches are stocked "single," "double" and "triple" pole for front and back connections. A larger number of poles can be made up on short notice. The switches are jig made, and all parts are interchangeable. The finish is copper and black.

"Hatfield" Pump for Railways.

The "Hatfield" treble barrel high speed reciprocating pump, of which Messrs. Merryweather & Sons are the sole patentees and makers, has found great favour among railways, and has been adopted by the Great Eastern, Midland, Great Central, Caledonian, and other companies. It is suitable for driving by various powers, such as electricity, gas, oil, petrol, steam, etc., and is made in sizes ranging from 6 to 1,000 gallons capacity per minute. A pump of this design, driven by electric motor, has recently been supplied to the Lancashire and Yorkshire Railway for a fire protective installation at the company's premises at Castleton. The pump, which is capable of delivering 600 gallons per minute at 100 lbs. pressure when running at 185 revolutions per minute, is driven by a 60 h.p. motor through silent chain gearing. The motor is fitted on sliding rails, enabling the chain tension to be adjusted as may be necessary in order to take up wear. The pump delivers through a system of firemain piping, with hydrants at various points. A relief valve is fitted, so that no damage will occur to the fittings between the time the hydrants are closed and the pump ceases to run. It is claimed that the "Hatfield" pump will deliver more water, at a greater pressure, for a given expenditure of power, than any other pump employed for fire purposes.

New Tantalums.

Messrs. Siemens Brothers Dynamo Works are placing on the market a new type of "Tantalum" lamp. It is a tubular bulb, 100–130 volts, 25 c.p., for single or series burning, at a list price of 3s., subject to the usual "Tantalum" lamp terms and discounts. The length is $5\frac{1}{4}$ in.



and the diameter $1\frac{1}{2}$ in. The lamp will burn at 1·7 watts per candle-power efficiency, and will be suitable for alternating or direct current circuits. We consider these lamps should have a very great vogue, especially for strip light reflectors for shop windows.

REVIEWS.

"Nightshade": A Novel. By Paul Gwynne. London: Constable & Company. Price 6s.

This is a weird book, made fascinating by the consummate literary powers of the author, who deals with the supernatural in a way which, apart from his master fiend, makes everything appear quite possible. Mr. Gwynne's hero is a musician, possessing eyes apparently perfect, yet so confused by white light that he is quite blind. Cases such as these have been recorded by science. But then comes along a rather grotesque sub-human, a mysterious demon, who has been dabbling in necromantic art for countless centuries. He has invented a kind of dark lantern, giving out some form of radio-active principle, which being turned on the blind musician's sightless eyes causes him to see nature around him darkly, and with more startling effect enables him to visualise the normally unseen. Mr. Gwynne suggests that our ether is thickly peopled with conceptions emanating from the human brain. At some distant time humanity has conceived devils of horrible forms, and these float about, away from the range of our vision, but possibly visible to creatures whose occular coherers are sensitive to shorter wave-lengths than those which reveal to us the normal spectrum. At all events, the mysterious Master Meisterlimmer (a name built up on the same principle as Carlyle's Dr. Teufelsdrork) with his dark lantern compels his blind victim to see horrible visions, and as there are two sisters in love with the musician, and he (thinking that there is but one girl) is in love with what he thinks to be two moods of one person, though really two distinct entities, and the demon is obsessed with a Rhodision lust for world empire—disasters dire follow. As an appalling climax threatens to overwhelm us, the primitive instincts of a woman bring the weary work of science to naught. The radio-active lantern is destroyed, Dr. Meisterlimmer disappears, and the musician regaining his blindness, we are allowed to catch a glimpse of the world lapsing into ignorance and happiness. This, perhaps, all sounds very confused, but Mr. Gwynne, with cunning artistry, merely suggests his science and philosophy, while he weaves his tale, and, were it not that the fiend himself is a little out of focus, a little too grotesque and unconvincing, the story spins along with scarcely a jog, realistically enough, just a touch of the nightmareishness making it piquant.

"Brazil: Its Natural Riches and Industries." Volume I.: Introduction; Productive Industry. Paris: Librairie Aillaud & Cie.

We have here the first volume of a comprehensive work compiled by the Commission for the Economic Expansion of Brazil at the command and cost of the Government. It is an official publication, and therefore authoritative as regards facts and statistics. In this volume we find an interesting historical sketch, followed by a closely detailed section on the geography, climatology, and population, concluding with a general survey of international commerce. All the above is preliminary. In the first part of the main body of the work we have sections dealing with vegetable, animal, and mineral products. The vegetable products here touched upon are chiefly rubber, fibres, oils and timber, so that coffee and cocoa remain for a second volume. In the same way the cattle trade is left over. The volume is adorned with a fine coloured map and a very large number of illustrations of a valuable character. Seeing the wonderful natural wealth of the immense Republic, and the wonderful way in which it has advanced within the last couple of decades, the work should appeal to a considerable circle of serious people. Brazil is of peculiar interest to the engineer, and certainly not least to the electrical engineer, who will find in that country vast opportunities for expansion. Although there are a few solesisms, and some oddities of typography, the work which is a translation and has been printed in France, is a very creditable production both to the compilers and the publishers.

CATALOGUES AND PRICE LISTS.

Wright & Wood, Ltd.: Price list and particulars of Motor Generators, Rotary Transformers and Converters.

Siemens Bros. & Co., Ltd.: Interesting illustrated pamphlet on Galvanic Batteries and their manufacture.

F. E. Emerson & Sons: Section I. of complete illustrated catalogue of Electric Bell-pushes, Fire Alarms, Contacts, Switches, Watertight Mining Pulls, Motor Car Plugs, Switches, etc.

Electro-Mechanical Brake Co., Ltd.: Pamphlet, "Our Reply to the Paper on Tramcar Brakes, recently read before the Institution of Electrical Engineers."

Sun Electrical Co., Ltd.: Illustrated catalogue of Electrical Accessories, Switches, Ceiling Roses, Wall plugs, Lampholders, etc. Section X, Part 1.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

I understand that an important order has very recently been placed with the Electrical Company (Newcastle), Ltd., by the well-known Middlesbrough firm of Messrs. Dorman, Long & Company, Ltd. As already recorded in THE ELECTRICAL ENGINEER, this firm has already a very large amount of electrical machinery installed, including an electrically operated cogging mill on the Ilgner system, by means of which, and the other portions of the electrical equipment, it is possible for the works to operate at a rate considerably in excess of the average, when this is necessary. My information is to the effect that this firm has now decided to install power plant, including turbine driven generators, on a very considerable scale, rendering the new equipment when completed very much in excess of the kilowatt capacity of some of our smaller municipal electric light and power stations. If this information is correct, Messrs. Dorman, Long will shortly be in the forefront of the manufacturing firms of this country who possess private power plants of very large dimensions.

Electric Extensions in Darlington.

From the fact that the Darlington Corporation have just ordered from the Gilbert Arc Lamp Company, Ltd., of Chingford, Essex, an installation of 56 arc lamps, it may be assumed that an energetic forward campaign in street lighting is now in process of execution by the municipality. This order confirms a rumour which was current some time ago that work of this nature was contemplated.

The Supply of Electric Power on Tyneside.

The energy with which the Newcastle-upon-Tyne Electric Supply Company, Ltd., and its associated companies, the County of Durham Electrical Power Distribution Company, Ltd., and the County of Durham Electric Power Supply Company, have pushed forward their power-in-bulk supply propaganda is too well known to be enlarged upon. A new phase of activity is now, however, in process of development. Mr. A. S. Esslemont, who has for many years been the manager of the County of Durham Electric Power Supply Companies, will shortly resign this position in order to devote his time to the development of electro-metallurgical and other process work on Tyneside on behalf of the Newcastle-upon-Tyne Electric Supply Company. The concentrating of such a well-known gentleman as Mr. Esslemont on this particular portion of development work is sufficient evidence of the importance of the movement.

Messrs. Swan, Hunter & Wigham Richardson, Ltd.

On Saturday, the 23rd inst., Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend, launched the largest vessel built on the Tyne, with the exception of the "Mauretania." The "Franconia," built for the Cunard line, is to be used principally in the Boston service, and will be the largest vessel to enter that harbour. It is 625 ft. overall by 72 ft. broad, and has a displacement of 25,000 tons. As it is intended to carry 200 first-class passengers, 500 second class, and 1,900 third class, the boat is very finely finished, and electricity will, as in all the other passenger vessels of this line, play an important part in the equipment. This firm of ship-builders have at present a very considerable amount of ship-building in hand, including a large floating dock for service abroad, in which electric light and power is to be very extensively used. They have also in hand an order for a sister ship to the "Franconia." This exemplifies the well-known fact that upon Tyneside electrical engineering rises or falls to a very considerable extent with the state of the ship-building industry.

The North-Eastern Railway Strike.

The very grave industrial deadlock which arose out of an apparently very trivial cause on the North-Eastern Railway is quite well known to every reader of the daily press, but its effect on the electrical industry may be pointed out. In the first place, the cessation of service on the electrified portion of the railway system put out of action a considerable amount of running plant, and had a very decided effect upon the load-factor of the generating station at Curville of the Newcastle-upon-Tyne Electric Supply Company, Ltd. In the next place, the impossibility of getting wagons to take away the output of the collieries caused a considerable number of these to shut down, and in the case of those pits which are fed by the electric power-in-bulk supply system, the effect of this stoppage was reflected upon the load. In the third place, the impossibility of getting goods through either to or from Newcastle and district caused serious trouble to more than one electrical manufacturer and contractor, and in one typical case the fulfilment of a contract within a specified period was seriously imperilled. It was fortunate that the strike was so short-lived, as although reserve coal was in hand for the power supply authorities operating in this area, the effect of a long-continued strike would have been disastrous.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

A paragraph in the recent report of the Lunatic Asylums Committee of the Birmingham City Council appears to call for some elucidation as to its bearing upon the relative merits of gas and electricity for the lighting of large institutions. The paragraph relates to the Winson Green Asylum, and states that the committee have recently given a good deal of consideration to the question of lighting at this asylum in view of the suggestions of the Commissioners that electricity should be substituted for the present system of lighting by gas. The committee add that having regard to all the circumstances, they are of opinion that the asylum should continue to be lighted by gas, and they have accepted the estimate of the Gas Department for a new installation of fittings, etc., to secure the most modern and efficient method of lighting by gas. The report does not state the reasons for this preference, but on enquiry from the Chairman of the Committee, it appears that they relate entirely to the special conditions in this case. The committee would have preferred electricity, but, mainly owing to the long distance of the asylum from the road and from the nearest electrical main, they found that an electrical installation would prove too expensive to justify them in recommending it to the Council. There would also be the additional cost of wiring a large building which is already fitted up for gas, and the committee could not see its way to incurring the cost of the substitution. No doubt, the fact that the Winson Green Asylum, which is by far the oldest of the city asylums, is altogether out of date in view of modern progress in the treatment of the insane, and sooner or later must be either abandoned or rebuilt, has had its influence in bringing about the committee's decision.

Hollymoor Asylum.

As showing the sincerity of the committee's preference for electric lighting, it may be mentioned that the Hollymoor Asylum, which has been erected by the Corporation a few miles from Birmingham, and has been planned in accordance with the latest ideas for such institutions, is not only lighted by electricity, but has also power installations for laundry, ventilation, and other purposes. The lighting provision is for 2,000 16 c.p. lamps. The generating plant

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consists of two Parsons' turbo-generators of 75 kw. each, and two Belliss & Morcom sets of 35 kw. each, driving Parker dynamos. The latter two sets are for lighting the asylum during the night in place of using storage batteries. Steam is supplied by four Lancashire boilers 7 ft. 9 in. × 30 ft., working at 120 lbs. to the sq. in. There is an independent condensing set into which the exhaust from the steam turbines is led. The plant was designed and its erection superintended by Messrs. Henry Lea & Son, of Bennett's Hill, Birmingham.

Mechanical Engineers and Electricity.

Reference has already been made to the papers to be read at the joint meeting of the Institution of Mechanical Engineers and of the American Society of Mechanical Engineers. In the papers read in Birmingham some passing references were made to electrical power in connection with the handling of locomotives at terminal stations. From a paper read by Mr. Cecil W. Paget (General Superintendent of the Midland Railway, Derby), it appears that electric lighting has not been largely adopted in England for engine sheds, though it was suggested that the introduction of metallic filament lamps may cause a different view to be taken from that formerly entertained as to the relative economy of gas and electricity. Hitherto, Mr. Paget explained, electric lighting in locomotive sheds has only been found economical where arc lamps can be used, and for most purposes such large units of light are not required. Electrical motors, however, appear to have been found advantageous for some of the operations in the running shed. The South-Eastern Railway Company, for instance, use a power driven elevator for coaling. The elevator consists of 20 buckets, each holding about half a cwt. of coal. The buckets travel on an endless pitch chain which runs over two toothed-wheels, one wheel being at the upper end of the frame under the roof of the stage, and the other at the lower end in a pit some 7 ft. below the floor of the coal space into which pit the coal is shovelled direct from the coal wagon. An electric motor placed on a bracket fixed to the roof of the coal stage and wall of engine shed, and making about 500 r.p.m., drives by belting a counter shaft on the top of the elevator frame; a pinion on this shaft gears into a spur wheel, which drives the top chain-wheel, the speed of the chain wheels being about 25 r.p.m. Mr. Frederick Whyte, in describing American engine house practice, also stated that for coal hoisting purposes electric motors were considered preferable where electric current was available.

High Speed Tools.

Mr. H. L. Brackenbury, of Newcastle-on-Tyne, in a paper on "High Speed Tools," discussed among other points the question of motive power, and for the larger machines advocated variable-speed motors worked on the D.C. three-wire system, as giving an excellent range of speed. He pointed out, however, in his diagrams that there is a drop in efficiency at the change from the low voltage to the high voltage, and an extraordinary gain in efficiency when a change is made from the high voltage and high-gear ratio to the low voltage and low-gear ratio, the result being that practically the same amount of power has to be paid for at cutting speeds of 18 and of 33 ft. per min. The motor from which the diagram was taken was rated at 40 h.p. on the high voltage, so that in one case a motor was giving from 50 to 75% of the full load and in the other case from 25 to 35%. His conclusion was that heavy lathes which are required to do both light and heavy turning, should have the gear ratio arranged so that the full range of speed may be obtained from either voltage, and that builders of such heavy machines should give the total efficiency of the lathe and motor at various speeds and loads. No engineer, he said, would purchase a power-generating plant without obtaining a guarantee of its efficiency at various loads, and there seemed to be no reason why less care should be given to the efficiency of plants using the power.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

A few weeks ago it was stated that the Gas and Electricity Committees of the Manchester Corporation were to confer together with the object of amicably adjusting differences existing between them. This matter is proceeding satisfactorily, and a sub-committee, consisting of prominent members of both committees, is now sitting, with the Lord Mayor as chairman, to consider a report prepared by the engineer, superintendent and accountant of each department. While not much is yet known of the contents of this report, it is understood that the officials are unanimous in recommending that the outstanding debt of each department should be taken as the basis on which to proportion the amount each should contribute towards the rates. By this arrangement the electricity department having £1,970,000 debt would pay nearly twice as much as the gas department, which has only about £1,213,000 outstanding debt.

Current Items.

At the last meeting of the Turton Urban District Council, correspondence was submitted from the Bolton Gas Department with regard to the lighting of local roads, the Council to repay the Corporation the cost of mains within 10 years. It was resolved to obtain a comparative quotation for lighting by electricity before deciding to adopt gas.

The accounts for the past year of the Electricity Department of the Bolton Corporation have recently been published. The gross profit on the year's working amounts to £34,941, which is nearly 10% on the capital expenditure. The amount of capital borrowed on the undertaking is about £355,000, of which about one-third has already been repaid. It is the practice at the Bolton station to write off yearly a large sum for depreciation, and in connection with this it is interesting to note the heavy rates at which depreciation is reckoned. Mains and transformers are taken at 6%, machinery at 7%, meters and motors and instruments at 10%, and well sinking at 20%. In addition, this year £450 worth of meters and £880 of motors have been bought out of revenue, while, as mentioned last week, the cost of the Duncan-street sub-station is also being met out of revenue. Since 1899, £56,080 has been paid towards relief of rates, and this year £6,500 is being so spent. The accounts give a very interesting table showing the generating costs in detail since the station was opened, when it cost 11·84d. to generate a unit which brought in 5·5d. The table shows a consistent decrease in works and total costs ever since. Last year the works cost, including coal, oil, waste and water, wages and repairs, etc., was ·436d., against ·472d. and ·487d. in the two previous years. The total cost, with rent, rates and taxes and salaries, was ·535d., against ·583d. and ·545d. In spite of the very heavy writing down of plant, the inclusive costs are down this year to 1·125d. The total average price obtained was only 1·18d. per unit, as against 1·23d., 1·26d. and 1·45d. in the preceding 3 years. Private lighting is 2·75d., trams 1·1d., and motors ·812d. in average figures. Last year over 14¼ million units were generated, or about 15% increase over the last year's figure. This was almost all due to the rapidly growing power load. Although the figure quoted for power is still very slightly above that at which mill owners are pleased to suppose they can produce steam power, still engineering works have been very quick to see and to make use of the advantages that electricity has to offer. It is estimated that the saving in cartage, etc., when the new station is built will be sufficient to bring the power price down to that which mill owners demand, even without the reduced costs resulting from the larger load.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

It is highly desirable that all concerned should put their shoulder to the wheel in connection with the Smoke Abatement Exhibition to be held in September and October at the Skating Rink, Victoria-road, Glasgow. Other forms of smokeless heat are likely to be well represented, and it behoves the electrical industry to avail itself of such an opportunity as this to demonstrate to the public the possibilities and the measure of the practical development of applied electricity. The manufacturers of apparatus are willing and anxious to push their wares, and the Glasgow Corporation Electricity Department give them every

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opportunity to do so; but both the manufacturers and the supply authority wish to be loyal to the contractor, and it is gratifying to report that a number of local contractors have taken space in the exhibition. One would again express the opinion that while this exhibition is being held under the aegis of the Corporation, it is largely a contractors' show, inasmuch as the failure of the contractors to take advantage of it will go a long way to strengthen the hands of those who are in favour of the municipal supply authority opening premises for the sale of electrical apparatus, as is already being done in so many boroughs south of the border.

The Glasgow Electricity Department's stall is to take the form of a house consisting of drawing-room, dining-room and bedrooms, with kitchen, laundry and bath-room with electric fittings and apparatus for lighting and heating throughout. There will be an up-to-date system of ventilation by electricity. Operators will show electric cooking apparatus in the kitchen, and flat irons, etc., in the laundry. Suitable booklets are being prepared, giving particulars and prices with current consumed in connection with the apparatus shown.

Electric Light in Flax Spinning Mills.

Messrs. John Fergus & Company, of Prinlaws (Fifeshire), an old-established firm of flax spinners with a reputation for keeping abreast of modern developments, have recently put down an installation of electric lighting with incandescent lamps throughout their mills. Availing themselves of the situation of their works on the River Lever, the firm have put down a 70 h.p. McDonald vertical turbine coupled to a 45 kw. Holmes' dynamo at 200 volts, regulated by a mechanical step by step regulator. The switchboard consists of throw-over switches, as there is a second dynamo capable of developing 50 amps. for pilot lighting. Two of the mills are lit with 16 c.p. Ediswan lamps, and in the third mill Tantalum lamps are used two in series. The distribution box is placed at the door of the flat in each case, thus giving the maximum of facility for economic working. The wires are carried in heavy wood casing fixed to the ceiling by bolts, and the wiring is on the "loop-in" system. Overhead bare copper wires run on insulators fixed on poles are used for connecting up the system with the various sections of the works. While the main purpose of the installation was the lighting of the works, the principal houses in the village have been wired and connected up and 32 c.p. incandescent electric lamps have also been put into the street lamps in place of gas. The whole work has been carried out by Messrs. Lowdon Brothers, of Dundee.

Reviving Trade.

The best evidence that trade continues to revive is afforded by the fact that the annual holidays have been curtailed in many large works in the West of Scotland, owing to the number of orders on hand requiring to be completed at the earliest possible moment.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

H. Zipp calls attention to the fact that more than half the accidents with electrical plant are due to contact of the victim with a live wire, and this emphasises the necessity of making sure whether a wire is live or not before running any risk of diverting the current through one's body. There are two well-known methods. If one pole of a telephone is earthed, while the other is connected with a large metal plate held near the wire, the telephone will emit a sound if the wire is carrying a current. If, too, a Geissler tube is hung up so that one pole touches the wire while the other is connected with a large metal plate or with a condenser, the tube will light up if there is danger. Zipp's own contrivance consists of an ebonite case containing a Geissler tube, and two glass condensers of suitable capacity. The tube being earthed the case is hung on to the doubtful wire, whereupon the tube lights up as a danger signal. For tensions up to 5,000 volts the apparatus is 9 in. long, and about 1 in. in diameter, and weighs about a pound.

A Huge Telephone Exchange.

The new telephone central at Hamburg, which has been in operation for a week or two only, is the largest establishment of the kind in the world. It is designed for 80,000 main connections and already contains 35,000 in operation.

Wireless in German Pacific Islands.

A conference, presided over by Under Secretary von Lindequist has just been held at the Colonial Office here, with a view to establishing wireless communication among the German possessions in the Pacific Ocean. About 20 interested merchants and others attended the conference. The chief matter discussed was linking up Samoa and New Guinea with each other and with the wireless system of the world generally. It was generally considered that Jap, one of the Caroline Islands which belongs to Germany, and is a cable station of the Deutsch Niederlandische Telegraphengesellschaft would be the best place for the erection of the proposed wireless installation.

Osram Lamps.

Remane gives some interesting figures referring to the use of Osram lamps for street and railway station lighting. Great pains have been taken to obtain the fullest and most accurate information possible. No less than 1,600 German electric works were circularised. It appears that 484 of them use Osram lamps for street lighting, the number of lamps being 33,643, with a total power of 1,640,000 hefner candles. According to illuminating power the lamps are divided as follows:—

Candle power..	16	25	32	40	50	70
No. of lamps ..	636	3,319	6,615	695	20,325	285
Candle power..	100	200	300	400	600	1,000
No. of lamps ..	1,379	135	81	113	56	5

For lighting squares and railway stations the more powerful Osram lamps compete sharply with arc lights. By such lamps is meant those of from 100 to 1,000 hefner candles (h.k.). At the Charlottenburg town station the staircases and passages used to be lighted by 36 twelve ampere alternating current arc lights. These have now been replaced by 90 Osram lamps, 86 of 100 h.k. each, and 4 of 200 h.k. each. This change has caused a saving of 5 k.w. per hour, and a total yearly saving of about £150. At a railway station at Erfurt 91 arc lights, 84 of them using 32 k.w. at 6 amperes have been replaced by Osram lamps, 89 of 50 h.k., 70 of 100 h.k., 20 of 200 h.k., and 1 of 400 h.k., all working with 220 volts. They save exactly half the current, using 16 k.w. instead of 32. Miners have found Osram lamps very useful in spite of the shaking to which they are subjected.

Company Notices.

An agreement has been entered into between the Vereinigte Elektrizitats Aktiengesellschaft of Vienna, the Aktiengesellschaft Brown, Boveri et Cie, of Baden, and Niederösterreichische Eskomptegesellschaft, in virtue of which a company will be formed in Vienna with a capital of 4½ million K., and be styled the Oesterreichische Brown Boveri Werke. The Vereinigte Company underwrites 2 millions, and the other two partners the remaining 2½ millions between them. 4½ million K. is about £200,000.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

While modern sanitary engineering has done magnificent service in the direction of improving those conditions of life in crowded cities which come immediately within its province, the fact that it is within the power of the electrical engineer to carry the work very much further is strongly insisted on in a striking editorial in the Chicago "Electrical Review." In the big cities of to-day, the writer urges, there are many features that directly result in a lowered resistance to disease and in the long run are bound to affect the vitality of the people. Among these unwholesome elements of city life are smoke, dust, dirt, crowded tenements and general lack of pure air. Even though there be developed in us a gradual immunity from infection from these sources, it is most desirable to remove the causes of

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possible danger, especially when by doing so the vigour of the race and the joy of living will be vastly increased. As an instance of the great need of preventive measures it may be noted that many medical authorities contend that over 90% of the human race becomes infected at some period of life with tubercle bacilli; in most instances these bacteria remain dormant or passive, but that the great stress of modern life, along with unhygienic living, particularly in cities, renders them all too frequently virulent and active again is attested by the great prevalence of the white plague. It is well, therefore, that the modern physician is interested not only in conserving our present state of health but in actively preventing disease and promoting a higher standard of living. It is in this service that electricity has lent its aid and it stands ready in almost innumerable ways to add to the well-being and comfort of the individual and of the public as a whole. One of the imperative needs of every city is the elimination of the smoke nuisance. Of the various measures proposed none is so comprehensive, and withal so thoroughly effective, as the concentration of all power, light and heat supply for the entire community in one or a few central stations. Regarding the first of these utilities, much headway has already been attained in the general use of electricity for power purposes, its cleanliness and convenience alone being sufficient reasons for its adoption in a large number of instances. When to these is added, in increasing degree economy in operating and maintenance costs, along with economy of space, etc., the elimination of the isolated power plant might even be ordered by the police powers of the community, because there is left no reason why the superior service of the central station with its entire absence of public nuisance should not replace it. As a community builds up and its factories and industries multiply, it is readily conceivable that the noxious gases belched forth from a multitude of chimneys alone becomes a public nuisance, even if dense smoke and soot be assumed to be absent. Among the worst offenders in the smoke nuisance of our cities are the present steam railroads. Electrification of their terminals is the only means by which the nuisances of their fuel-burning locomotives can be completely eliminated. It is not only feasible but economical and the public health alone may make it imperative.

The Domestic Aspect.

About the only reason still advanced in favour of isolated plants in our cities is the need of heat supply. Although electricity has not yet been much used for the heating of buildings on a large scale, the marked development of district heating, particularly in connection with electric central stations, removes the last excuse for the isolated plant. It is even conceivable that the public demand for pure air will compel the exclusive employment of centrally developed heat for heating our residences and apartments, although ultimately electricity may be used as successfully for this service as it is for cooking, ironing, etc. The hygienic value of electricity for lighting is well known to all. Its freedom from vitiation of the air should make its use in confined places imperative, and moreover it is cleaner and does not heat the air. For the propulsion of our street cars electricity is now universally used. As the density of street traffic increases urban transportation is forced to seek elevated or subway lines. Electricity is used exclusively on these systems, in fact, without it the subway lines would be a serious menace to the public health. The increasing use of the automobile is reducing the nuisances attendant on the employment of horses on the streets. On the three types of automobiles, gasoline, steam and electric, the latter is the least obnoxious. The sanitary removal of dust in our homes has been materially aided by the use of vacuum cleaners, whose extensive employment has been made possible by electricity. It is becoming very common for owners of apartments to equip them with vacuum cleaning systems for the use of the tenants. The use of the electric fan is a material aid in improving the ventilation of apartments. In these and other ways the objections to people living in close quarters are being reduced by electric service. On the other hand, the perfection of electrical means of urban transportation has enabled more people to live in the suburbs and less densely inhabited parts of our cities. The general use of electricity, particularly in our cities, along the lines referred to and others, is becoming one of the most noteworthy means for preventing disease, and therefore of conserving the public health.

Electricity for Railways.

In connection with the papers on the electrification of railways which are to be read at the joint meeting in London of the British and American Mechanical Engineers, it may not be inopportune to give an abstract of some conclusions presented by Mr. F. Darlington in a paper read recently before the Richmond Railway Club. Mr. Darlington's point is that while electric motive power has demonstrated certain advantages over steam power for railways, the result of this experience does not fully measure these advantages, because electric railroads have never had equal opportunities with steam railroads. The latter were well established and in successful operation and occupied all of the best territory long before electric railroads were developed. Further, electric railroad apparatus has only recently reached a state of development where it is economical to instal and operate it for all kinds of railroad work, and even now it is not economical under all conditions. Then, again, steam railroads (especially well-established and successful roads) get money at much lower rates of interest than newly-projected electric railroads do; and, furthermore, they have in their organisations some of the ablest and best-trained men in the country, who have grown up with the business, while electric roads, at least at their commencement, have generally been in the hands of less experienced men. But the future holds in store a great career for the electric railroad. The managers of electric lines are realising their power in the domain of freight as well as passenger service. They find that because of their convenience and economy for light local work their place is to originate and build up traffic, both freight and passenger. They hold the key to much of the first-hand business, which is the non-competitive business, or the business that originates and terminates with the customer at the smaller local points where there is no competition. This is especially advantageous in freight traffic, as it secures the benefit of high local rates. Electric roads are developing local carrying business, in spite of the fact that their apparatus is a development of apparatus originally intended to replace horses on city street cars, and does not possess the qualities needed for heavy railroad work; yet it is pretty well demonstrated that, even with present equipments, electric railroads will largely extend their business to include much local short-haul non-competitive freight traffic.

System of Operation.

Mr. Darlington goes on to point out that the comparative operating characteristics of steam locomotives and various types of electric locomotives, have an important bearing on the commercial aspect of electrification of railroads. Most steam locomotives will maintain a stronger draw-bar pull when moving slowly than when going rapidly. Steam locomotives, generally, will not maintain the maximum draw-bar pull which they are capable of, if they are speeded up to more than 8 or 10 miles her hour for freight locomotives and about 15 miles per hour for passenger. On steam locomotives designed for freight service, if you increase their speed from 15 to 30 miles per hour, you generally halve the pull that they are continuously exerting. In the case of passenger locomotives, the continuous tractive power is about halved for an increase of speed from 20 to 40 miles per hour, and for steam locomotives in general, through quite a wide range of speeds, the tractive power that they can exert continuously is about inversely proportional to their speed. With electric locomotives, the variations in tractive power, with changes in speed, are very different, and demonstrate enormous advantages over the steam locomotive. Direct current and single-phase locomotives can take advantage of light grade sections by operating at considerably higher speed than when at full capacity, thus making their schedule speed over the entire division higher than the continuous full load speed would indicate. For three-phase locomotives the relation of speed to tractive effort is different. Three-phase locomotives operate with best efficiency only at substantially constant speed. By introducing certain devices, known as series connections, one-half normal speed can be obtained with good efficiency, and by using another scheme called a double winding and

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pole changing device, double normal speed good and efficiency may be obtained. At constantly varying speeds these motors are inefficient, and no matter how light the grade or load, three-phase locomotives cannot pull a train any faster than a certain predetermined speed. A higher running speed is necessary for the three-phase locomotive than for the other locomotives at their continuous capacity rating, because three-phase locomotives cannot take advantage of light grades to run at high speeds as can direct-current and single-phase locomotives. Of the two alternating current systems, the single-phase system is the most generally applicable to the widely-varying conditions of transportation. It is suitable alike for light and for heavy trains, for fast speed and for slow speed, for variable speed, with frequent stops, or for constant speeds, for infrequent service, scattered over long distances, or for heavy service, concentrated within short distances, for switching and making up trains, etc., to meet all the needs of railroading. The three-phase system, on the contrary, is especially well-suited for one class of railroad work only—namely, hauling heavy trains at constant speed and constant tractive effort, but it is not so well suited as the single-phase system to meet the various other needs of railroads.

High Tension Transmission.

At the recent meeting at Jefferson of the American Institute of Electrical Engineers a paper was presented by Messrs. Hayden and Steinmetz on "Disruptive Strength with Transient Voltages," in the course of which the authors pointed out that high-frequency oscillations and other disturbances of limited power do not exert as high a disruptive effect on oil and solid insulation as should be expected from their voltage. As such transient disturbances are frequently caused by switching and other causes, a knowledge of the ability to guard against them is highly desirable. For this reason the authors undertook an investigation of the dielectric strength of air and of white paraffin oil when subjected to transient voltages. For producing single high-voltage impulses a direct current was impressed on the primary of a high-voltage transformer. During the rise of the current in the primary a momentary voltage impulse was set up in the secondary between whose terminals a spark gap was placed. By varying the primary current the energy back of this impulse was regulated. A large number of tests were made with needle points and with spheres of 3·8 centimeter diameter. The energy values used in the tests varied from 0·01 to over one joule. A summary of the chief conclusions arrived at from the results of the investigation is as follows: The disruptive discharge through a dielectric requires not merely a sufficiently high voltage, but also a definite minimum amount of energy. The disruptive discharge goes not occur instantly with the application of voltage, but a finite though usually very small time elapses after the application of voltage, before the discharge occurs; during this time the disruptive energy is supplied to the dielectric; the authors call this interval the "time lag of the discharge." The disruptive strength of oil seems to be about 30 times greater than that of air, and that of solid dielectrics probably is still greater. An oil gap thus requires a greater time before it discharges than an air gap, but even an air gap does not discharge instantly. An air gap therefore can protect an oil gap against momentary voltages, but not inversely. With limited available energy, the striking distance increases slower with increasing voltages and drops below the striking distance with unlimited energy; alternately the striking distance becomes entirely independent of the voltage and merely a function of the energy. At constant energy, with increasing voltage, the striking distance seems to approach constancy in a hyperbolic curve. The voltage at which the striking distance has become practically independent of the voltage is the lower the more limited is the amount of available energy.

Electric Strength of Air.

This paper was followed by one by Dr. Whitehead describing his method of determining the breakdown voltage of the air between a central wire and a surrounding metal cylinder, a method which permits the determination of the electric strength of air near round wires within 0·5%. Temperature and pressure cause the greatest variations in the electric strength of air near a given wire. At 760 millimeters pressure there is a drop or rise of 0·22% in the electric strength of air per centigrade degree rise or fall from 21° C. Water vapour or moisture has no influence on the electric strength of air; increasing moisture content probably lessens the loss above the critical voltage. There is no loss through air until the critical voltage accompanied by ionisation and corona is reached. The electric strength of air is independent of the material of the wire or terminal. The critical voltage may be markedly lowered by dirt and surface impurities; this lowering may be as great as 33%. The corona is periodic but ceases at a somewhat lower value on the voltage wave than that at which it begins. The corona has high conductivity and most of the loss takes place beyond it.

Transform Regulation.

Another noteworthy paper read at the same gathering was presented by Professor Adolph Shane, who questioned the accuracy of the results obtained in the common method of calculating transformer regulation by adding the impedance volts vectorilly to the impressed pressure, the impedance data being obtained by the short-circuited secondary method and the measurement of the resistance of the windings. He therefore devised two new methods, and found them to possess a very high degree of accuracy, and to check each other perfectly. In his direct method two transformers, *A* and *B*, exactly alike, are connected to the same source of power with their secondaries connected in opposition series; the voltage between the open ends of this series connection is zero until load is applied to one of the transformers, when this voltage is equal to the true impedance pressure of the loaded transformer. A third transformer, *C*, is similarly connected with its secondary in series with the other secondaries, but in opposition to that of *B*. A galvanometer is connected between the free terminals of this secondary series system. Normal load is applied to *A* and the secondary winding of *C* gradually cut out of circuit, turn by turn, until the galvanometer reads a minimum. The voltage of the secondary of *C* is then the regulation volts for the transformer *A* and is read directly by means of a low-reading voltmeter. The data for Professor Shane's calculated method are obtained by connecting the two transformers *A* and *B* as in the first instance, inserting in the load circuit of *A* a wattmeter of large enough current range and low-voltage pressure circuit, which latter is connected to the open terminals of the secondary series connection, precisely where the low-reading voltmeter is connected to read the impedance volts. The wattmeter reading is the true I^2R loss of *A* under bad conditions; this reading divided by the load current gives the IR drop. Thus the impedance triangle can be accurately determined and the regulation easily calculated. No difficulty has been found in getting two exactly similar transformers. Professor Shane's two methods check perfectly with each other and with the comparatively crude method of taking load and no-load readings with an ordinary voltmeter. The methods have been tried with numerous commercial transformers and with only commercial instruments and in each instance results of high accuracy were obtained.

Current Items.

Electric traction has received a great impetus in Chicago by the fact that the Supreme Court has sustained decisions of the Circuit Court that the city has the right to build subways and to use the traction fund, amounting now to nearly $4,500,000, for that purpose. Subway planning was slackened because of this litigation; but now it is believed that no similar obstructionist tactics will avail to check advance to effective and final accomplishment.

A new telephone law has been laid down by the St. Louis Bell Telephone Company, abolishing double 0, double one, double two and so on in making calls. Thus in future 1200 will be called "one, two, 0, 0," and 1244 will be "one, two, four, four," and 2266 "two, two, six, six," and so on. A long series of tests, it is claimed, shows far greater accuracy where single figures are thus repeated than when "double two double four" is the formula.

As an illustration of the great advance made in the popularisation of electric automobiles for pleasure and for commercial uses, it is announced that the National Lead and Battery Company has increased its capital stock to $5,000,000, and will at once begin extensive additions to its plant at Niagara Falls. The company manufactures storage batteries.

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Business Notes and News.

LIGHTING AND GENERAL—Home.

ASTON.—A Local Government Board Inquiry has been held into an application for powers to borrow £23,500 for purposes of their electricity undertaking. The Inspector, while complimenting the local authorities on the success of the electricity department, deprecated raising loans for cost of services, which should be paid out of revenue. He strongly advised keeping down capital expenditure when this had to be met by borrowing.

BARNSTAPLE.—The Town Council propose applying for a Provisional Order empowering the Electricity Department to undertake wiring for private consumers.

BRADFORD.—The Corporation are allowing consumers to come in on a new system of rating, namely, a fixed yearly charge of 3s. in the £ of rateable value, plus ½d. per unit for whatever purpose used.

BRIERLY.—The District Council have renewed their contract with the Corporation of Nelson for the supply of electricity for a period of three years. The price has been reduced from 2½d. to 2d. per unit for lighting purposes, and from 2d. to 1½d. for motive power.

BRUMBY AND FRODINGHAM.—It has been decided to proceed with the proposal for lighting the streets by electricity.

DUNDEE.—In the Electricity Department the revenue account shows that the increase totalled £7,935 13s. 4d., and the expenditure £4,950 14s. 11½d., leaving a gross balance of £2,984 18s. 4½d. The total liabilities amount to £60,231 9s. 3d., and the assets to £64,298 11s. 8½d., leaving a surplus of assets of £4,067 2s. 5½d. The net revenue account shows a credit balance of £67 2s. 5½d.

EDINBURGH.—The City Electric Light Committee has been able to report an actual surplus of £8,263 in place of the estimated surplus of £2,020.

EXETER.—The Corporation are making a reduction of ½d. per unit for power and heating purposes.

ERITH.—While the municipal electricity undertaking shows a net profit of £2,157 on the past year's trading, there was a loss of £3,436 on the tramways.

FALMOUTH.—The Town Council are considering the advisability of buying the Electric Light Corporation's undertaking. The Council possesses an option to purchase which will soon come into operation. Meanwhile, the Council has agreed to allow the Corporation to take a supply of water from the Trelawney-road source for £2 10s. for six months, and this in spite of a protest from the Water Works Company.

LAUNCESTON.—The Electric Lighting Corporation, Ltd., having given notice that they were unable to proceed with the lighting scheme, the Board of Trade proposed to revoke the Order unless the Town Council had some proposal to make. It has been decided to ask for time, as Mr. J. A. Purves, of Exeter, who formed a local electricity company at Parington, has offered to take over the Order and form a company to carry out the scheme.

LIMERICK.—Mr. Clayton, of London, has been retained to report upon the Corporation's electricity undertaking and to make whatever suggestions may be necessary to ensure economical working.

LESLIE.—The Fife Electric Power Company are seeking powers to supply electricity in Leslie Burgh.

LIMEHURST.—The District Council not having applied for an Order under the Electric Lighting Act, the Oldham Corporation is anxious to supply certain districts, notably Alt, and negotiations are going forward to that effect.

LONDON, BERMONDSEY.—The Borough Council's Finance Committee is perturbed over the fact that the Electricity Department only had a net surplus of £45 instead of the £500 estimated. The present indebtedness is £152,973, and it is recommended that no further loans should be made and that the price for current should be increased. Meanwhile the London County Council are seeking to have the rateable value of the works increased from £1,796 to £3,000, and not £2,266 as put forward by the Borough.

NORWICH.—The Corporation Electricity Department has done exceedingly well. The income was £37,632 (£37,189 in 1908–9), and the expenditure £16,169 (£18,053 in 1908–9). The cost per unit has thus been reduced from 2·20d. to ·943d. There has been a reduction in sale of current for power purposes, but this is regarded as only of a temporary character.

PENZANCE.—The town is to have an electric service on or before December 31, 1911. Mr. W. T. Pressland, of Broadsanctuary, Westminster, has written on behalf of the Penzance and District Electric Supply Company, Ltd., that it was not necessary to erect a generating station, as electricity would be bought in bulk from the Cornwall Electric Supply Company's station at Hayle. On the consent of the Board of Trade being obtained, the work of laying cables and preparing for house connections, will be taken in hand at once.

SOUTHEND.—Extensions of the municipal electric lighting mains are to be made to the extent of 340 yards, at an estimated cost of £158. Mr. Robert Birkett, the electric engineer, has already carried out extensions in Surbiton-road, Highcliff-drive, and Leigh-road, an extension of the traction feeder in Southchurch-avenue, and a lighting pilot wire from Victoria-corner to Marine-parade, with the result that 56 new consumers have been secured.

TORQUAY.—A Local Government Board inquiry has been held into an application for powers to borrow £3,500 for purposes of electric lighting extensions. Ultimately it was decided to increase the demand to £4,500.

LIGHTING AND GENERAL—Overseas.

AMSTERDAM.—The Municipality propose to purchase some new machines for their electric power works. They also intend to enlarge the depôts for the electric tramcars.

DEVENTER, HOLLAND.—A project for the establishment of a central electric power station for the towns of Deventer and Zwolle has been adopted by the Municipal Council of Deventer.

KLERKSDORP.—In connection with the proposed Klerksdorp electric lighting scheme, three schemes were recently submitted to the Council for consideration, and after full discussion the Council has adopted one of these, and resolved to apply forthwith to the Government for its approval. The estimated cost of the adopted scheme is about £9,500. When the matter was under discussion, it was explained that a complete double establishment was provided for, thus obviating risks of breakdown and also insuring light all night if needed and power during the day, which will most likely be used in connection with the water scheme pumping as well as private concerns.

LAUNCESTON, TASMANIA.—The City Council have adopted the following resolutions of the Committee: (1) The installation at the power station of a steam auxiliary plant of 500 h.p., generated by coal; (2) that tenders for supplying the same be forthwith invited, on the basis set out in the report of the city electrical engineer of March 14 last. Therefore tenders for supplying the auxiliary plant will be invited on the following alternative bases: (1) high-speed steam engine of the speed and size required to enable it to be directly coupled to one of the existing alternators, the latter being removed to a foundation provided alongside the engine; (2) manufacturers' standard high-speed steam engine coupled direct to a new alternator; (3) steam turbine, with new alternator.

TRIPOLI, SYRIA.—The municipal authorities are examining the question of the construction of an electric generating station for lighting purposes, electric tramways, telephone system, waterworks, and a harbour with the necessary quays, warehouses, etc.

URUGUAY.—The Government has accepted the tender of the Telefunken Company for the installation of wireless telegraph stations along the coast, at various towns of the interior and on the vessels forming the fleet.

TRACTION—Home.

ABERDEEN.—The total income from the City tramways was £71,121, and the expenditure £40,451. Of the gross profit of £30,669, £16,015 had to be paid in interest, sinking fund, etc., leaving a net balance of £14,652 to be carried to renewal account.

BEXLEY.—An agreement has been come to between the Erith and Bexley Councils, whereby through running of trams will be secured. The Erith Council is to pay the Bexley Council for the use of the line over Northumberland Heath and current 5d. per car mile, for a minimum of 50,000 car miles, and 3·05d. per car mile above the minimum, with a rebate for demi-cars, the rebate to be fixed by actual tests.

CARDIFF.—The firm supplying the Corporation tramways with the 130 meters have, we understand, guaranteed that the cost would be covered out of energy saved in one year, and that if at least 6% of energy were not saved in the first six months they would take back the meters free of cost.

EXETER.—Besides introducing meters on the tramcars, the Tramway Committee have secured a reduction of ½d. per unit of current supplied by Corporation works.

SOUTHEND.—The Light Railways and Electric Lighting Committee have under consideration the duplication of a further portion of the permanent way.

TRACTION—Overseas.

VANCOUVER, BRITISH COLUMBIA.—Plans have been completed for the new terminal building of the British Columbia Electric Railway Company. The structure, completed without furnishings, will represent an investment of about a quarter of a million. There will be ample room for the entrance of three tracks at the Hastings-street front. The building on the west will parallel the C.P.R. tracks, and on the east will run along Carrall-street. The building will have a steel frame and the bulk of the other material used will be reinforced concrete, faced with stone.

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COMPANIES' MEETINGS AND REPORTS.

GENERAL ELECTRIC.

The ordinary general meeting of the General Electric Company, Ltd., was held at 67, Queen Victoria-street, E.C., Mr. G. Byng (chairman of the company) presiding.

The Secretary (Mr. K. Alwood) having read the notice convening the meeting and the auditors' report, Mr. Byng said that they were glad to show a good increase of profits—£95,000 this year, against £78,000 last year, a difference of £17,000. The appropriation of the available balance had been the subject of much consideration, and the board had decided to propose, as hitherto, a dividend of 5% on the Ordinary shares. They were increasing their reserve fund by £22,000, and had commenced a new policy of carrying forward a substantial sum. These measures would considerably strengthen their financial position. They were bound to increase, in order to keep abreast, even to a limited extent, with the powerful foreign electrical firms, and were often called upon to find large sums at short notice. Hitherto they had used their credit for such purposes; but in future they intended to invest part of their reserve fund in convertible securities, which they hoped would enable them to rely upon their own resources. The balance carried forward exceeded £8,000—enough to cover the full amount of interest on their debentures. The conservative policy especially strengthened the position of the preference shareholders, and he trusted that the quotation of the Preference shares would soon represent their intrinsic value. He had before him several letters with regard to the quotation of their Preference shares, which was now at a very low figure in the Stock Exchange list. That was a matter of some surprise to him, as well as to others. He had found out that certain outside stockbrokers had been offering these shares without having any to dispose of. Each time, lately, that these shares had been offered he had tried to buy them; but he had never been able to get them, and yet, after his acceptance of the offer, he had found that the same outside stockbrokers had been writing round to shareholders offering to buy their shares at a very low figure. It was obvious, therefore, that the quotation was not a true one, and he hoped that the shareholders would not be frightened into throwing their shares on the market.

The directors were proud of the success which they had lately achieved in the production of telephone exchange equipments. The English telephone industry had in the past been in an ignominious position. They had been especially well fitted to produce telephones, and in the inception of the industry England was far ahead of any other country. Yet this important industry had been strangled in its infancy, and for over 20 years the English and Colonial telephone companies had had to buy all their equipments and instruments from foreign makers. He was pleased to say that a change had at last been made by the British Post Office. They had been very far-sighted in insisting on getting English-made apparatus, in spite of deep-rooted prejudice, due mainly to mistaken notions in regard to the economical aspect of the question. The General Electric Company especially had to thank the Government for much encouragement. The result had been most satisfactory to both parties. The company had now completed the installation of one of the largest and most important telephone exchanges in the kingdom—every particle, every screw, being made at their Salford works—as well as, and he was assured even better than, the foreign equipment which held the monopoly for 20 years. They had also nearing completion the installation of another Post Office exchange. Further, they had well in hand an exchange equipment for the Australian Commonwealth, and they had supplied similar plant to the Indian Government. Besides these exchange equipments, they had manufactured, and were manufacturing, large quantities of telephone apparatus for the British Post Office and the Colonies. Moreover, the apparatus was to designs prepared by the company. But the strangest part remained to be told. The prices at which the Post Office was now buying in England were far below the foreign prices paid formerly. For instance, instruments previously supplied by the foreigner were now produced in this country and sold at rates lower than the old prices by various percentages running up as high as 30%. This would explain why the company had devoted the whole of their Peel Works to the manufacture of telephone apparatus, and they were carrying it on now as a subsidiary company, called the Peel-Conner Telephone Works, Ltd., under the able management of Mr. M. S. Conner. Their biggest enterprise, the Witton Engineering Works, had turned out very good work, and its excellent staff and workers had again increased the reputation of the company's products throughout the world.

They were keeping the flag flying over their carbon works, although they had not yet been able to show a profit in face of foreign competition. The advent of the flame lamp had helped them very much, and in the making of flame carbons they had succeeded in beating the quality of almost all their continental competitors. They had been greatly encouraged by the policy pursued by the Admiralty, who had recognised the importance of a carbon factory in England. Their example was now being followed by most Government departments; but they had much to complain of the action of many municipalities. They had increased their foreign depôts and agencies in order to find outlets for our large factories. The sales and influence of the Osram lamp had fulfilled the board's expectations. The wonderful efficiency of this great invention had reduced the cost of electric lighting to less than that of gas. Thousands of Osram lamps were in use to-day that had burned over 6,000 hours—a durability truly astonishing. They regretted to say, however, that their patent rights had been greatly infringed, and they had been compelled to take legal proceedings against infringers, both on the master patent as well as upon minor patents, of which there are many. He concluded by moving the adoption of the report.

Mr. H. Hirst seconded the motion, which was unanimously carried.

The Chairman next moved, Mr. Hirst seconded, and it was resolved that a dividend of 5% be declared on the Ordinary shares.

The retiring director (Mr. Max Railing) and the auditors having been re-elected, the proceedings terminated with a vote of thanks to the chairman and board of directors.

CROMPTON AND COMPANY.

The annual statement of accounts made up to March 31 last states that during the financial year competition for business has been keener than ever before experienced, and orders have been difficult to obtain. With a view to keeping the company's works employed a considerable amount of business has been taken at works cost, with the result that the output has only fallen off to a comparatively small extent. The gross profit realised on trading has not been sufficient to pay administration and selling expenses, while the completing of a large contract in the East has entailed a heavy charge on the year's accounts. The directors also regret that litigation in connection with an order for pumping plant has involved the company in the special legal expenses. The loss for the year, after making the usual full provision for depreciation and charging all repairs against revenue amounts to £20,493 2s. 10d., as compared with a profit of £10,051 10s. 4d., for the year ending March 31, 1909. After providing for debenture interest and other charges shown in the net revenue account, and after deducting the balance brought forward from last year, there remains a debit balance on this account of £23,368 18s. 9d. The guarantee of the Auxiliary Electric Company in connection with the earnings of the Electric Supply Corporation has now expired, and the final adjustment should shortly be arrived at. The directors have decided to write down the company's holding in the Electric Supply Corporation to £4 per share, taking the necessary amount from the reserve fund for that purpose. The claim under the policy of insurance held by the Auxiliary Company has been settled on terms which are considered favourable; under the settlement the company's holding in the Electric Supply Corporation has been reduced by 3,000 shares of £5 each, £3,000 has been written off the investment in the Auxiliary Company, and the right of the insurance company to the first £10,000, repayable by the Electric Supply Corporation under the guarantee, reverts to the Auxiliary Company. During the financial year expenditure on patents and experimental work has been

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considerably in excess of the average. This increase is in connection with an invention which is likely to prove of great value to the company. All such expenses have been charged against revenue, but a sum of £600, being the purchase price of a patent which it was important that the company should control, has been added to patents account. In view of the continued depression in the electrical manufacturing trade, the directors have taken steps to further reduce expenses, and with that view are arranging to move the headquarters of the sales department to the company's works, which it is estimated will effect considerable economies. Although there appears to be an improvement in the volume of the trade of the country, the slight increase in the demand for electrical machinery has not affected market prices. At the same time, the directors are of opinion that by the exercise of the most rigid economy a margin of profit can be earned, even on the basis of the present low prices. Since the close of the financial year an improvement is noticeable in the value of orders coming from colonial and foreign sources.

BOMBAY ELECTRIC SUPPLY.

The fifth ordinary general meeting of the Bombay Electric Supply and Tramways Company, Ltd., was held at the Electrical Federation Offices, Kingsway, London, W.C., Sir Edward Sassoon, Bart., M.P. (chairman of the company), presiding.

The Chairman said: It gives me and my colleagues much pleasure to be able to congratulate the shareholders upon the satisfactory progress made by our undertaking during the past year. As you will have seen from the report, the net receipts resulting from the past year's operations amount to £82,695 13s. 8d., as compared with £67,066 16s. 3d. the previous year, an increase of £15,528 17s. 5d., or a little over 23%. After deducting the interest on the Debenture stock and the half-year's interest on the Second Debentures, issued in June, 1909, amounting, together, to £30,530 5s. 9d., there remains the sum of £52,165 7s. 11d., to which is to be added £9,385 9s. 1d., the amount brought forward from the previous year, making an available total of £61,550 17s. Our total revenue from all sources, including the amount represented by the sale of current to the tramways, amounted during the year to £197,827 19s. 3d., an increase of £19,972 7s. 6d. over the revenue for the previous year, and this additional revenue was, you will be glad to note, obtained by an increased expenditure of only £4,343 10s. 1d. The augmented revenue from the tramways accounts for £8,628 of the gross increase, and the receipts from the electricity supply branch accounts for £9,837. The volume of our traffic continues to expand, if not as rapidly as we could wish, still, with a steadily progressive upward growth. In order to deal with this expansion, your directors have found it necessary to consider the question of the provision of additional rolling stock. After making experiments with trailer-cars, it has been decided to construct 10 new single-truck cars, each seating 38 passengers, which will be attached to existing cars, and will run as double-car trains. This will add considerably to the carrying capacity of our rolling stock at rush hours, and will do so in the most economical manner available. Coming now to the electricity supply section of the undertaking, it will be seen that the total receipts amounted to £57,552 19s., as compared with £47,714 2s. 10d. of the previous year, while the working expenses were £40,934 17s. 8d., as against £39,737 3s. 9d. for 1908, so that from an increased expenditure of about £1,200 the company has obtained an increased revenue of over £9,800 in this department. The balance carried to profit and loss account is £16,618 1s. 4d., as compared with £7,976 19s. 1d., or an increase in profit of £8,641. During the year under review we secured 281 new consumers, taking supply representing the equivalent of 36,505 eight-candle power lamps. The expansion of this branch of our business still continues. Up to the end of April last we have this year added a further 101 consumers. After giving the matter their most careful consideration, your directors have decided that it will be to the interest of the business to substitute a tariff of flat rates for the present maximum demand system.

The new tariff which we propose introducing has not yet received the concurrence of the municipality. In drawing up the new tariff, we have kept in view two principal aims: Firstly, we have desired that the system of charging should be absolutely simple and intelligible; and, secondly, we have aimed at arriving at results, as to the actual cost of current supplied to consumers under the new rates, which will alter as little as may be the present cost per unit paid by our customers under the existing tariff. During the year the capital expenditure amounted to £41,136 16s. 3d. Of this sum, £11,981 was spent on tramways—chiefly on the provision of additional rolling stock—and £25,806 was expended in further developing the electricity supply branch, principally on the extension of the mains, and the balance of £3,349 (including the proportionate amount of London expenses) represents the expenditure in connection with the issue of the Second Debentures, as well as other items which are not specifically chargeable to either branch of the undertaking. This Second Debenture loan was issued to meet the cost of the new power house at Kussara Basin, which we are building and equipping. We regret that we have not yet been able to pay a dividend on our Ordinary shares; but we have confidence that the patience which these shareholders have had to exercise in the past will be compensated by the growth of our profits in the not distant future. I beg to move: "That the report of the directors and statement of accounts for the year ended December 31, 1909, now before the meeting, be, and the same are hereby, received and adopted, together with the recommendation contained therein, and that the payment of the Preference dividend, as mentioned therein, be confirmed."

Sir Walter Hughes, C.I.E., seconded the motion, and it was agreed to.

EDUCATIONAL.

UNIVERSITY OF LONDON: KING'S COLLEGE.

The syllabus of the day and evening classes in the Faculty of Engineering is now out. In Electrical Engineering the syllabuses cover technology, design of machinery and apparatus, and generation, transmission and distribution of electrical energy. The fees are moderate: For Day Classes, course of lectures and laboratory work as for second year regular students, ten guineas for the winter session; for third year students, eighteen guineas. Three courses of Evening Classes are given: (i) Elementary Class, by Mr. F. S. Robertson, demonstrator, on Wednesdays; (ii) Advanced Class, by Professor E. Wilson, on Mondays, commencing October 11, the syllabus covering D.C. and A.C. working; (iii) Advanced Class, by Professor Wilson, on Mondays, commencing April 30, the syllabus including power-house and sub-station equipment, transmission, motor equipment, controllers, recent developments in A.C. traction. In (i) and (ii) the fees are one guinea per term, or a guinea and a half for the winter session, and a laboratory fee of three guineas for the winter session; and for (iii) two guineas and a half. The laboratory is splendidly equipped. It is to be noted that certificates depend partly on a written and partly on an examination of work done during the course of study.

UNIVERSITY OF LONDON: UNIVERSITY COLLEGE.

In another column will be found full details of Faculty of Engineering. Winter Session, commencing on October 3. The fee for that full three-year diploma course, including the course for graduation (B.Sc.) is 120 guineas, but students who have already undergone a partial training elsewhere may enter for a course occupying less than three years and qualify for a General Certificate of Engineering after not less than two consecutive sessions.

CITY AND GUILDS OF LONDON INSTITUTE.

At a meeting of the Council the diploma of "Associate of the City and Guilds of London Institute" was awarded to the following matriculated third year students of the Central Technical College, who have completed a full course of instruction as prescribed by the Council:—J. D. Peattie (awarded Siemens Memorial Medal and Premium), M. de Angelis, W. S. G. Baker, W. Barrs, P. R. Blamey, H. Clark, H. M. Dunkerley, D. H. Green, W. C. Griffith, G. E. W. Hitchcock, A. E. D. Kennard, G. Lambert, A. W. M. Mawby, P. A. McGee, D. J. McHatton, R. F. Niven, N. J. Perryman, L. C. Pocock, F. C. L. Racker, N. N. Roy, L. L. Ruderman, J. McL. Thornton, G. H. Tilly, F. J. Vinsen, G. Watts.

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PATENTS.

Optical Electromagnetic Speed Indicators.

9242—1909. J. W. HENWOOD, Streatham. The speed indicator comprises the combination with a series of vibratile fingers which have different natural vibration periods, of an electromagnet and an armature connected with the moving part whose revolutions or reciprocations are to be indicated. The electrical intermittent impulses transmitted to the electromagnets are applied to the series of fingers and cause the particular finger whose vibration period accords with the periodicity of the impulses to be set in vibration. This, by the position of the finger in relation to stationary companions, or its disclosures of a finger on a scale of numbers concealed by the fingers so long as they are not in vibration indicates the speed.

Dynamo Electric Machines.

11956—1909. M. WALKER, Hale. The object is to provide an improved machine in which the voltage generated at the direct current brushes of the machine can be varied while the voltage on the alternating current side of the generator or converter remains constant. According to the invention the strength of the magnetic field under the poles and the length and resistance of the conductors connecting two adjacent commutator bars are so proportioned that it is possible to rock the brushes over a wide arc and even right round the commutator without causing sparking, so that by rocking the brushes forward or backward a wide variation of voltage on the direct current side can be obtained.

Electric Ovens.

14548—1909. J. G. CHILDS AND T. S. HILL, London, N.W. The oven comprises an outer wood casing with a marble top and an inner metal casing which forms the oven proper. The outer casing has an opaque door, which is adapted to retain the heat. Between the casing and the oven is a padding of asbestos. The door of the oven is of glass and is supported in a metal frame on hinges insulated from the oven.

Holders for Electric Lamps.

14763—1909. A. E. LAMKIN AND T. R. NUNWICK, Croydon. The holder has slots at its lower end in which pins work projecting from an internal ring which is furnished with means for attaching the lamp. The pins are connected to springs which are also connected to pins projecting from the holder.

Electric Clocks.

14873—1909. F. HOLDEN, Temple, E.C. The pendulum is energised by making and breaking the current in a coil which has relative movement with regard to a magnetic field. The pendulum carries a pivoted pin which hangs in a vertical position and wipes over a fixed contact for energising the coil during a small portion of the swing of the pendulum.

Magazine Electric Arc Lamps.

15287—1909. JOHNSON & PHILLIPS, LTD., AND J. BROCKIE, London, E.C. A system of levers connect the carbon magazines with the regulating lever of the lamp. These levers are so shaped as to transmit a gradually decreasing movement to the holders as they approach each other so that when they have arrived at a certain proximity any further movement of the lever does not produce any change in the distance separating the carbon holders and therefore any further movement of the lever is utilised in starting and stopping the motor mechanism which permits the progressive feed of the carbons out of the magazine nozzles.

Quick Make and Break Electrical Switch.

15441—1909. VERITYS, LTD., AND W. G. PIPKIN, Covent Garden, W.C. This is an improvement in fly-on and fly-off switches. The switch blade is pivoted just inwards of one of its ends to a U-shaped bracket fixed to the switch base. The bracket has notches which engage with a locking piece. A hand lever controls the movement of the blade.

Devices for Producing Electrical Oscillations.

16558—1909. POLYFREQUENCY ELEKTRICITATS, G.m.b.H., Hamburg. The device is provided with a conductor which has a number of very small gaps and an oscillatory circuit arranged parallel to the conductor. The gaps are filled with a bad conducting medium. The electrodes are composed of a number of concentric rings connected with one another in such a manner that a number of gaps are formed in each electrode, and that a spark is able to travel from one ring across the separating gaps to a corresponding ring in an adjacent electrode through a conductor to another ring in the adjacent electrode across the separating gap to the corresponding ring in the other electrode and so on.

Electric Switches.

16649—1909. A. WEST, Russell-square, W.C. The Switch has a control part and a switch part with a spring to be compressed by the control part to engage and disengage the switch part. These two parts are mounted on a divided spindle the axis of which is common to both its parts. The compression device is disposed between the control spindle and the switch spindle. Levers with compression pivot centres of unequal length from the common axis of the spindle carry the compression device.

Electric Motors.

17863—1909. D. MAGGIORA AND M. SINCLAIR, Sutton. The motor has a single rotary member and means which can be adjusted for different conditions of supply of the current to render the driving power of the motor practically constant. These means allow the motor to operate under various conditions with practically no waste of electric power.

Varying the Intensity of Light of Electric Lamps.

19465—1909. A. DE STEFANO, Naples. This device for varying the intensity of electric lamps and which permits the use of low voltage lamps on high voltage circuits comprises a switch member that vibrates under the influence of a magnetic field generated by a current the strength of which periodically falls to zero. Spring members are used for the armature and contact, and are so arranged that a practically continuous vibratory movement of the armature can take place. The lamp circuit remains closed during a part of each vibration, and is opened whilst the armature is moving away from the magnet at a point where the current has zero value.

Installation of Electrical Conductors.

21021—1909. J. S. HIGHFIELD, London. Flat insulating strips are provided which carry two or more conductors. The advantage of the flat strips is that the bending of the wires is simplified. The outer wire is bent in the plane of the strip and the inner wire is bent up and out of the plane of the strip. The bend is covered by a mental casing which is secured to the wall on which the strip is fastened.

Insulator for Supporting Current Rails of Electric Tramways.

21526—1909. A. WATKINS, Chelsea. The insulators which are lined with wood have a vertical hole in which a wooden dowel fits. The dowel holds the liner in position between the insulator and the current rail.

Electric Heaters.

21564—1909. J. C. ROYCE, Toronto. The heater coil is formed from a thin flat strip of metal which is wound in volute form. A layer of insulating material is wound between the coils of the metal strip. A metal band is adapted to be placed around the periphery of the coil. The ends of the band are drawn together to bind it to the periphery of the coil.

Electric Telegraphy.

23429—1909. A. MUIRHEAD, Shortlands. In the telegraph receiving apparatus a stretched wire contact maker continuously vibrates against two conducting surfaces. When deflected this causes the actuation of a local receiving instrument or cable relay.

Producing Continuously Sustained Oscillations.

24134—1909. H. MANDERS, London, W. In this apparatus for the production of undamped waves of electricity the maintenance and sustenance of the continuity of their trains is caused by the automatic regulation of the critical length of the arc by a system of reciprocal action between mechanical springs and an electromagnet in which the plane of the discharge is vertical and the planes of the discharging areas of the electrodes are parallel to each other.

Electrical Ignition Apparatus.

29026—1909. H. W. VAN RADEN, Handsworth. In this apparatus for internal combustion engines a single interrupting device is adapted to make and break magneto and battery circuits successively or one after the other without permitting current to flow from the battery to the magneto.

Electric Motor Power Transmission.

722—1910. W. FARRELL, Philadelphia, U.S.A. The frame, armature and rheostat of the motor are all mounted in openings in a heavy revolving body so that a pinion connected with the armature will travel around the outer periphery of a stationary track in the form of a spur wheel. By mounting the motor upon the revolvable body so that the the revolutions of the armature of the motor are exchanged on the outer periphery of a stationary spur wheel for the revolutions of the frame of the motor secured to the revolving body an enormous mechaniacl purchase is given to the motor whereby it is capable of making a full revolution around the centre in a known manner without a change or reverse in movement.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year.							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	July 20	1 712	1,894	— 181	+ 87	27½	27½	May 31	71,930	17,517,804	1,566,119	·98	11·02	4,940,	5·98
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+2,071	—	·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	July 17	1,142	1,115	+ 27	+ 274	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	July 16	6,745	6,300	— 445	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	July 16	5,567	4,938	+ 629	+2,109	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	July 24	1,039	1,028	+ 11	— 415	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	July 22	5,977	5,973	+ 4	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	July 23	1,259	1,185	+ 74	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	July 24	280	278	+ 2	— 41	6½	6½	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	July 23	5,642	5,427	+ 215	+1,012	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6 822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	July 24	3,127	2,989	— 138	— 14	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	July 21	553	580	— 27	+1,668	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	July 8	1,650	1,561	+ 89	+2,562	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	July 22	175	159	+ 16	+ 17	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	July 22	5,888	5,937	— 49	+ 573	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	July 23	1,026	1,167	— 141	+ 218	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	July 16	18,392	16,961	+1,431	+9,488	194½	189	May 31	907,494	226,946,290	20,766,722	·96	10·49	5,080	5·88
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	July 23	2,726	2,516	+ 210	+2,837	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	July 13	133	135	— 2	— 93	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	July 20	1,339	1,341	— 2	— 447	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	July 17	1,447	1,434	+ 13	— 98	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	July 13	43,020	35,705	+ 7,315	+ 91,042	133	118½	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+ 57	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	July 23	10,738	10,926	— 188	+ 1,311	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	July 24	16,927	16,623	+ 304	+ 1,138	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,710	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	July 16	3,796	3,743	+ 53	— 437	60½	59½	„ 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	704	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	455	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,096	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	July 17	5,985	5,717	+ 267	+ 5 482	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	July 13	1,155	1,073	+ 81	+1,118	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	June 29	142	133	+ 9	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	July 16	1,107	1,009	+ 97	— 361	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	July 14	2,591	2,364	+ 227	+1,437	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. b Half-year's figures.

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NOTES.

Sub-Marine Lighting.

It has been proposed to replace buoys lit by acetylene, or other illuminant, marking harbour and river channels, by submerged electric lamps. The plan is to lay a cable on both sides of the channel, with connecting cables, to which would be attached lanterns, consisting of water-tight non-corroding metal boxes, having a convex lens on their upper surface. These boxes would contain incandescent metallic filament lamps, whose light, projected upwards by the lenses, would form large luminous patches on the surface of the water, visible from a considerable distance. The main cable itself could be lifted for inspection or repair, but the lanterns would each be separately anchored, and being provided with a sufficient length of connecting cable could be brought to the surface one by one for individual attention. There would be several advantages in such a system. Light would only be used when actually wanted and lighting up would entail no expense. There would be a gain in the channel way for smaller craft by removal of buoys, which form an obstruction.

X-Ray Suggestions.

In the Radiology and Electricity Section of the British Medical Association's Annual Conference, just held at the Imperial Institute, Sir J. J. Thomson dealt with certain aspects of the Röntgen rays and those given out by radium. His point was that there were soft rays which could not penetrate far through solid substances, and hard rays possessing great powers of penetration, these latter being used for taking photographs, while the former were utilised for curative purposes. The hard rays pass through the body without suffering any enormous diminution, but the energy of soft rays could be absorbed quite easily by a very thin layer of flesh. He had little doubt that all the terrible results which had fallen from the application of the Röntgen Rays had been due to the fact that in the earlier stages of the manufacture of the tubes for producing the rays a considerable amount of the soft rays was produced and absorbed by the surface layers of the skin. It was, however, important that they should develop the methods of producing the very soft Röntgen Rays. But the production of these soft rays directly from Röntgen tubes was a matter of considerable difficulty. It had long been known that when Röntgen Rays struck against metal the metal produced secondary rays. An old pupil of his had made an important discovery, which was that when a piece of metal or any substance was struck by the Röntgen Ray that substance gave out a special quality of Röntgen Ray. Iron, for instance, gave out a perfectly definite kind of radiation. Silver, when struck by the rays, gave out another quality of the rays, and the quality of the rays given out by any metal was constant. They had got in this way a perfectly definite means of reproducing Röntgen Rays of a specific type, from extreme soft down to radiation, which went through the body. Might it not be possible, for medical purposes, to use that radiation given out by those metals instead of trying to produce soft radiation? It seemed to him that there might be some application of that very interesting result to medical purposes.

Radio-Activity and Cancer.

Dr. Louis Wickham, of Paris, was at once cautious and hopeful in his references to the X-Rays and radium in the treatment of malignant growths. He declared that the X-Rays had a real field of usefulness in relieving pain, in reducing the activity of inoperable growths, but when they examined the absolute curative value of this method of treatment, disappointment awaited them. Personally, he had never known an unequivocal malignant growth absolutely disappear under the influence of X-rays, though, apparently, others had occasionally been more fortunate. Turning to another side of radio-therapy, as provided by radium, it was necessary to speak haltingly, to avoid too enthusiastic hopefulness on the one hand or a too niggardly acknowledgment of what radium had effected on the other. If they scrutinised the results of treating growths which were undoubtedly malignant they found much which was promising, but little that was conclusive. The final impression left by Dr. Wickham was that both electricity and radio-therapy would attain their greatest use when the science of diagnosis had advanced sufficiently far to enable these growths to be attacked at the earliest periods of their manifestation. Then cure might be looked upon as sure.

New Mono-Rail Car.

Particulars of a new form of mono-rail car, the invention of a Belgian engineer, come from Germany through the Consular service. It appears that the essential feature of this new system (which has been called the "Isopedin") is "the use of two forms of wheels as mobile supports of a car. Two or more strong, heavy wheels in a tandem sequence directly under the axis of the car are constructed with the proper flanges so as to run upon a monorail, and two additional wheels, larger but lighter, one on each side of the car at the extremity of an axle. The first series support the load almost entirely, and are directly coupled with the motive power, as well as subject to the action of the brakes; the second pair of wheels serve simply to maintain equilibrium, carrying but a fraction of the load, the effects of any unevenness of the ground over which they move being communicated in very slight degree to the framework of the car. The advantages in this new system is in the cheapness of construction, dispensing with the gyroscope attachment and with its motor, air pump, air-tight inclosure, etc. There is also a saving in weight. By a simple mechanism two light wheels, one on either side, can be lowered at will so as to run even on the ground with the main pair of wheels, while being in firm but elastic connection with the body of the car."

Competition in Brazil.

It will be remembered that a Canadian concern, the Rio de Janeiro Tramway, Light and Power Company, Ltd., received a concession to supply electricity for light and power, generated by water power, until the 7th of June, 1915. There had been hopes that this concession would have been prolonged, but recently the President of the Republic affirmed in his Message the policy of "free competition," and now effect has been given to this doctrine. Mr. E. Guinle, acting as president of a local company, the Brazilian Electric Power Company, has entered into a contract with the Prefecture of the Federal District of Rio de Janeiro whereby he undertakes to supply electricity for municipal, industrial and domestic purposes within the urban and rural districts. The company has to commence supply within a given time, but it may not supply hydro-electric power before June 8, 1915. Before that period the current must be of thermic generation. A special clause safeguards the rights of the Canadian company, but, as above stated, only so far as the use of

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water power is concerned. There, indeed, seems to be a suggestion that the Canadian company's right to the exclusive service of hydro-electric power may be contested, by legislative or other means. This new departure is chiefly of interest in regard to future enterprise in the Republic, where, it is evident, monopoly concessions will not be favoured.

West Ham's Overdraft.

The moral of the tragi-comedy on which the curtain was rung down in the Chancery Division of the Law Courts on Friday last, is that local authorities must be exceedingly wary in their endeavours to promote the prosperity of their trading concerns to remain strictly within the limits laid down by the Local Government Board. In this case the Attorney-General, acting at the instance of the India Rubber, Gutta Percha and Telegraph Works Company, Ltd. (ratepayers), sought for a declaration that the West Ham Corporation had no right to obtain overdrafts from a bank for purposes of their electricity undertaking. At an early stage the bank (while declining to admit liability) undertook to refund to the Corporation £7,000 charged as interest for the overdraft, and to pay certain costs. In his considered judgment, Mr. Justice Neville held that the overdraft obtained for general purposes in respect of borrowing powers granted for specific purposes was *ultra vires* and illegal; that the application of money due to the Consolidated Loans Fund in repayment of such overdrafts was *ultra vires* and illegal, and that the borrowing of money from the bank for the purposes of the electricity account otherwise than in exercise of borrowing powers with the sanction of the Local Government Board was *ultra vires* and illegal. There are points that make this case specially hard, but it is obvious that legislature having laid down certain rules for the guidance of local authorities in their business transactions, and set the Local Government Board over them as the authority to which they have to appeal, such regulations must be observed. If this were not so, the door to all kinds of abuse would be opened and anarchy would prevail.

REVIEWS.

"Practical Electro-Plating." By G. Gentry. London: Percival Marshall & Company. Price, 1s. net.

This is No. 9 of "Marshall's Practical Manuals," and while elementary, is, as with all these little books, sufficiently comprehensive, and very lucidly written. The subjects dealt with are electro depositing, the electric current and its manipulation, definition of terms, sources of current, silver and gold plating, nickel plating, copper depositing and plating, electrotyping and polishing. Over 40 clearly drawn diagrams and pictures help materially towards the full understanding of the text. This latest is quite worthy of an admirable little series.

"The Green Book of London Society." Edited by Douglas Sladen and W. Wigmore. London: Whitaker & Sons, Ltd. Price 5s. net.

Mr. Sladen who edited "Who's Who" in its present form for some years, has, with the co-operation of Mr. Wigmore, produced a concise and comprehensive book of reference. A useful feature is the alphabetical directory of British titles, which enables any titled person to be quickly traced to his or her rightful lair, though the detailed information of an ordinary peerage is missing. Here will be found lists and addresses of people holding official positions, or occupying some prominence in the world of letters, art, science, drama, or affairs. Much other information is comprised within the leaves of this new claimant for public favour, and wherever possible such information has been compressed into tabular form.

"The Telegraphic Transmission of Photographs." By T. Thorne Baker, F.C.S., A.I.E.E. London: Constable & Company. Price 2s. 6d. net.

Mr. Baker for upwards of two years has been in charge of the pictorial telegraphic department of the "Daily Mirror," and we all know with what success he has worked at his branch of an intricate science. In this little book he has set out to tell in as plain, non-technical language as is possible, the whole story of how pictures are transmitted by telegraphy. He tells of the work of others at home and abroad, describes their apparatus and results achieved, and discourses of his own researches and victories. A series of diagrams and reproductions of photographs add to the practical usefulness of a very interesting and suggestive essay, which should be in the hands of all those who study the deeper problems of telegraphy.

"Practical Electrical Engineering for Elementary Students." By W. S. Ibbetson, B.Sc., A.M.I.E.E. (London: E. and F. N. Spon, Ltd. 3s. 6d. net.)

In this handy and well-printed volume of some 150 pages, Mr. Ibbetson, of the London County Council School of Engineering at Poplar, presents for the use of the student fifty experiments dealing in turn with current measurement, the measurement of resistance, the fall of potential and its applications, potentiometer measurements, photometric measurements, and the principles of the motor and the dynamo. The scheme of practical experiments is lucidly drawn up and appropriately illustrated, and the book should prove of first-rate value to students in the earlier stages of electrical laboratory work.

"Electrotechnics," by John Henderson, D.Sc., F.R.S.E., A.M.I.E.E. (London: Longmans, Green & Company. 3s. 6d.)

This is the third of the very valuable series of Physical and Electrical Engineering Laboratory Manuals by the well-known head of the Physics and Electrical Department of the Borough Polytechnic Institute. In these manuals Dr. Henderson has sought to provide a course of instruction for carrying out a progressive series of experiments so arranged that the ordinary resources of a laboratory may be brought into operation without necessary recourse to costly apparatus, and a special point is the arrangement of experiments which can be satisfactorily carried out by a student working alone. The work is admirably done, and the manual may be warmly commended.

"Wireless Telephones and How They Work," by James Erskine-Murray, D.Sc. (London: Crosby Lockwood & Son. 1s. 6d. net.)

In the course of nine short chapters Mr. Erskine-Murray, who is well known as lecturer on wireless telegraphy and telephony at the Northampton Institute, contrives to give a singularly clear exposition of the principles underlying the wonders of wireless communication with sufficient freedom from purely technical language to render the whole subject plainly intelligible to the layman. The book deserves, and doubtless will achieve, wide popularity.

"Elementary Experimental Electricity and Magnetism," by W. T. Clough. (London: Methuen & Company. Price 2s. 6d.)

Mr. W. T. Clough, head of the Physics and Electrical Engineering Department of the East Ham Technical College, has prepared here a concise guide on the theoretical and practical sides of electricity and magnetism for the use of students preparing for the Oxford and Cambridge Local and kindred examinations. His long experience in teaching has enabled him to compile a book which will not only be useful in preparing for examination, but in giving the student a firm grasp of the elementary facts of the electrical science. In his introduction he deals with measurement, force, mass, weight, work, but pre-supposes in the reader a fair grounding in these subjects. He then passes on to magnetism, electrostatics and voltaic electricity. The subject is arranged in well marked paragraphs, and experiments are given to prove each point. There are 198 such experiments. Moreover, 235 illustrations, mostly diagrams, are employed to elucidate the text. At the end of each chapter a series of questions are given. In the appendix we find various examination papers set by the Oxford Local (junior and senior candidates), Board of Education, and London University; also a good collection of tables of physical constants. The book should fill a useful place in the equipments of students proposing to enter electrical engineering as a profession, and to that larger class taking up some other branch of engineering, to whom a working knowledge of electricity is becoming more and more a necessity.

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Mechanical Engineers Joint Meeting.

The very successful joint summer meeting of the Institution of Mechanical Engineers and the American Society of Mechanical Engineers was brought to a close on Friday last by the reading of five papers dealing with railway electrification, at the Institution of Civil Engineers, Great George-street, Westminster, S.W. After the visitors had been formally welcomed on behalf of the Civil Engineers, Mr. John F. Aspinall (President of the Institution of Mechanical Engineers) voiced the regret of the joint meeting that Mr. George Westinghouse (President of the American Society of Mechanical Engineers) was unable, as he had intended, to be present to read his paper. Mr. Westinghouse had written a special letter, explaining that the paper would be read by his representative in England, Mr. C. F. Scott, a past President of the American Institution of Electrical Engineers. Each of the papers dealt with the subject in an interesting and different way, but Mr. Westinghouse's paper, which came last on the list, pleaded for a careful consideration of the systems which ought to be adopted to enable railways which were electrified to interchange their trains, and he urged that they should consider the subject from a careful commercial basis. He (Mr. Aspinall) thought that the whole question of success—commercial success—of electric railways was dealt with in a very striking manner by Mr. Pomeroy. "The idea is all too prevalent with the public, and even with some of the bodies that have been given legal power of supervision over railway companies," Mr. Pomeroy pointed out, "that any expenditure which can be forced upon the railway companies is just so much gain for the public. Never was there a more absolute fallacy. In the long run the cost of every bit of railway improvement must be paid for by those who buy tickets and ship freight. Economy in the administration of our railways is just as important in the interest of the general public as if the railways were actually under Government ownership." Mr. Aspinall submitted that that was the direction in which they had to look in order that their electrical railways might be successful.

The papers were then submitted *seriatim* as follow:—"Electrification of Suburban Railways," by Mr. F. W. Carter, of Rugby; "Cost of Electrically Propelled Suburban Trains," by Mr. H. M. Hobart, of London; "Economics of Railway Electrification,"* by Mr. William B. Potter, Member of the A.S.M.E., of Schenectady, N.Y. (presented on his behalf by Mr. H. H. Barnes, jun.); "Electrification of Trunk Lines," by Mr. L. R. Pomeroy, Member of the A.S.M.E., of New York (presented by Mr. Calvin Rice); and "Electrification of Railways," by Mr. George Westinghouse, President A.S.M.E., of Pittsburg, Pa. (presented by Mr. Scott, past President of the American I.E.E.

ELECTRIFICATION OF SUBURBAN RAILWAYS.

By F. W. Carter, of Rugby.

Many of the railways of this country have, so far as their suburban passenger traffic is concerned, been affected very adversely in recent years by the great increasing competition of tramcars and motor-omnibuses. The companies concerned appear undecided at present between giving up a great portion of this class of traffic permanently and endeavouring to regain it by electrification of their suburban lines. The latter expedient, although an expensive one, has hitherto invariably been found successful in regaining much of the lost traffic, and the problem confronting a company in regard to any section of its suburban lines is that of determining whether the expected gain from electrification will justify the expense to be incurred.

Modern electric railway apparatus leaves little to be desired in the matter of freedom from breakdown, the delays from all causes electrical and mechanical for the month of December, 1909, averaging about 33 seconds per day per train on the District Railway and only 2½ seconds per day on the Underground Electric Railways tubes. The total cost for maintenance and repairs of rolling stock on these lines does not exceed 0·6d. per car-mile.

There are 18 electric railways at present working in this country, including seven tube lines; these comprise about 200 miles of route in all, and are for the most part worked by motor-coaches, employing a multiple-unit system of control. The coaches are generally of the saloon type.

In typical suburban service the greater part of the energy-input is used in accelerating the train, and the energy-consumption per ton-mile depends principally on the nature of the schedule; in fact, this energy-consumption is a good measure of the difficulty of a schedule, but an even better measure is the uniform acceleration that would cause the train to reach the mean running-speed in a distance equal to the average distance between stations. This acceleration is greatest for the Liverpool Overhead Railway's schedule, a fact which explains the high energy-consumption per ton-mile actually found in this service. A high initial rate of acceleration involves great mechanical strains on the bogies, and should not be employed unless the difficulty of the schedule renders it necessary. The equipment losses during acceleration are of the same order of magnitude in the continuous-current and the single-phase systems, in spite of the rheostat losses in the former system.

The performance of a given electric train under given conditions of suburban service can be very closely predetermined, for the factors liable to uncertainty have but small effect on the result. Schedule calculations, however, are inadequate by themselves to determine the question of the suitability of an equipment, as the limiting features are usually connected with the heating of the motors, which again depends on the energy-loss in the motors. This loss is much greater in the single-phase system than in the continuous-current system.

There appears little prospect of general electrification of the railways of this country, as no advantage is apparent which would in any way justify the expense. It is only in the case of heavy suburban service that there is prospect of commercial advantage accruing from electrification, and whilst there may be other local opportunities for electrical working, there is at present no indication that the steam-locomotive can be superseded with advantage for ordinary main-line work.

COST OF ELECTRICALLY-PROPELLED SUBURBAN TRAINS.

By H. M. Hobart.

Electrical propulsion permits of increased speed and capacity, relieves congestion, and increases revenue, for suburban passenger traffic, and permits of the retention of steam-locomotive methods for long-distance traffic. Different systems of electrical propulsion of suburban trains vary greatly as regards the capital outlay per train and also as regards the consumption of electricity per train-mile; consequently in any project for electrical working, it is necessary, not only to compare electrical with steam-locomotive methods, but also to compare alternative *electrical* methods. Preliminary cost estimations are facilitated by assuming that the railway purchases its electricity from electricity-supply companies who themselves own all works up to the distributing system and who supply the electricity in the form in which it is consumed by the train. The chief items of cost, which are different from those entailed by steam-locomotive methods and which are different with different electrical systems, are:—

1. The cost of the electricity.
2. The annual charges for the rolling stock.
3. The cost of the distributing system (overhead trolley-line or conductor-rails and the feeders) between the points where the electricity-supply company delivers the electricity, and the trains.

*These two papers, given in abstract below, will be printed in full in future issues.

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For the purposes of the Paper the assumption is made (with reservations) that item 3 is independent of the particular electrical system employed, and the estimates are narrowed down to items 1 and 2, which, for suburban passenger trains, usually absorb some 35 to 40% of the gross receipts.

The two electrical systems subjected to comparison are the systems employing series-wound, continuous-electricity train-equipments (termed the continuous system) and the single-phase system. Continuous equipment provides, per ton of equipment, 11 h.p. at the axles (averaged over the journey), as against 6 h.p. per ton in the case of single-phase equipment. In both cases the cost is some £125 per ton of electrical equipment. For a service where trains pass in each direction at intervals of some 12 to 15 min., representative figures for the cost of the electricity as delivered to the railway company in the required form (that is, from the sub-stations) are: 0·87d. per kw. hour for continuous electricity and 0·70d. per kw. hour for single-phase electricity.

Taking into account that the total consumption (after allowing for non-remunerative train movements and for unavoidable departures from the regular time-table) is some 30% greater than the consumption per recorded train mile, the cost of electricity per recorded train mile is, for 180-foot trains, shown to amount, for single-phase trains, to from 10d. to 15d. per train mile, and for continuous trains, to from 10d. to 13d. per train mile. The lower values are for a 22 miles per hour 1-stop per 0·88 mile service (that is, for a comparatively moderate service) and the higher values are for a 30 miles per hour 1-stop per 1·32 mile service (that is, for a decidedly severe service).

The annual charges for the rolling stock for these two services amount to from 8·6d. to 10·5d. per train mile for the single-phase trains and to some 6d. per train mile for the continuous trains.

The cost of the electricity plus the annual charges for the rolling stock, that is, the sum of the above two items, is, in the case of single-phase trains, some 3d. higher per train mile for the moderate service and some 6d. higher for the severe service, than the corresponding costs for continuous trains.

Fixing ideas by assuming the gross receipts in these cases to be 50d. per train mile, the single-phase system, compared with the continuous system, absorbs, for the two items in which the selection of the particular electrical system affects the question most greatly, 6% more of the gross receipts in the case of the moderate service and 12% more of the gross receipts in the case of the severe service.

The estimates worked out in the Paper show that, for suburban passenger traffic, the continuous system has very decided commercial advantages over the single-phase system, and these advantages are greater the more severe the service, that is, the greater the schedule speed and the shorter the distance between stops. This is the precise class of work where electrical methods afford to railways commercial advantages which are unattainable by steam-locomotive methods. For services where there are many miles between successive stops and where a considerable time elapses between the passage of successive trains, the use of steam-locomotives permits of commercial advantages which are unattainable with any electrical systems comprising the feature of transmitting the energy to the train.

ECONOMICS OF ELECTRIFICATION.

By W. B. Potter.

Mr. W. Bancroft Potter's paper dealt in a broad and comprehensive spirit with questions of first cost and operation. He observed that the utilisation of higher trolley potentials, made possible with direct current by the development of the commutating-pole motor, and with alternating current by the development of the single-phase motor; the higher speeds of rotary apparatus in the sub-stations; and the development of the steam turbine, have effected a material reduction in the investment required and the cost of operation. There would undoubtedly be an advantage in having the character of the energy supplied to the contact conductor uniform, but this is out of the question on account of the great difference in the requirements of specific conditions, such as congested urban or suburban service and comparatively infrequent trunk line train movement. Mr. Potter discussed in detail, and illustrated with tables, the conditions determining equipment, and arrives at the conclusion that while "the single-phase system, by reason of the apparent simplicity of its elements and the utilisation of higher potential for the contact conductor than is possible with direct current, is admittedly very attractive, there is the other side of the question, namely, that it is impossible to build a single-phase commutating motor comparable in first cost and maintenance with a direct current motor." The objections to the single-phase system were thus summarised by Mr. Potter: Excessive weight of rolling stock; excessive cost of rolling stock; high cost of equipment maintenance; increased power consumption; rapid depreciation of motor; rapid depreciation of car bodies and trucks; and increased cost of maintaining track and road-way.

In his conclusions, Mr. Potter observed that the saving effected by the 1,200-volt direct-current system is so marked that a great increase in the adoption of this potential for this class of interurban rail-roading may be anticipated. Reliability of operation is of the greatest importance, not only to the public but to the operating company, and in this respect the electric motor with its simpler construction, even though the general service is supplied from a central power station, has proved its superiority over the steam locomotive. The multiple-unit idea, to which electric service is so well adapted, was utilised in the design of the Mallet type of steam locomotive where the driving engines of two practically separate locomotives are supplied with steam from a single boiler. Mallet locomotives have been built having a weight of 441,000 pounds on the drivers, the boiler having over 5,800 square ft. of heating surface and a grate area of 100 square ft. To fire properly a locomotive of this capacity is difficult, and unlike the electric locomotive, its effectiveness depends on the steam from its own particular boiler. With existing road clearances the steam locomotive unit, controlled by a single engineer, seems to have reached nearly the limit of power. The power of a steam locomotive being limited by the capacity of its boiler, an increase in speed can be secured only by a proportional reduction in tractive force. The electric locomotive on the other hand, is supplied with practically unlimited power from an independent power station, and can maintain a speed and tractive force that would be impracticable with a steam locomotive. The application of electric locomotives to passenger and freight service will result in faster schedules with equal or even heavier trains than are at present handled by steam locomotives. Since the electric locomotive is equipped with a number of independent motor units, controlled by one engineer from a single master controller, it makes no difference, considering the complete locomotive as a machine, whether it be built as a single unit, or as two or three units having the same total weight on the drivers. For convenience in operation and repairs, it is probable that a single electric locomotive unit will be limited to a weight between 200,000 and 300,000 pounds on the drivers, even when built for the heaviest service. There are electric locomotives now under consideration which as single units will exert a maximum tractive effort of 90,000 pounds, and which will be capable of maintaining a tractive effort of 35,000 pounds at a speed of 30 miles per hour.

ELECTRIFYING TRUNK LINES.

By L. R. Pomeroy.

Mr. L. R. Pomeroy's paper emphasised the conclusions arrived at by Mr. Bancroft Potter with regard to tractive power. In heavy work, he pointed out, the limiting feature of the steam locomotive is the boiler, and the maximum adhesion can be utilised only at low speeds. For example, a 2–8–0 locomotive with 180,000 lbs. on the drivers, has a tractive force, at 10 miles per hour, of about 40,000 lbs. or 4·5 to 1. At 30 miles per hour the tractive force becomes 13,250 lbs. or 30·2 to 1. As tractive force governs the tonnage hauled, the ability of the electric locomotive to utilise almost indefinitely power proportional to the maximum adhesion and produce a drawbar pull entirely independent of the critical speed of a steam locomotive, as limited by

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the boiler, is a marked feature. In heavy grade work the ability to increase the speed shows up favourably to the electric locomotive as enlarging the capacity of a given section, but here also the business has to be sufficient to absorb the increase in fixed charges. With steam locomotives a coal consumption, when running, of 4 to 5 lbs. per indicated h.p. really means 6 or 7 lbs. at the rail, when the losses due to firing up, laying by in yards and sidings, blowing off at the pops, and consumption of the air pumps, are taken into account. Whereas, under electric operation, with an efficiency of 65 to 70% between the power house and the rail, a coal consumption of 4 lbs. per kw.-hour at the rail can be counted on.

Mr. Pomeroy went on to point out that on mountain grades or in heavy freight service, where the boiler of the freight locomotive is forced to the limit, and the boilers are designed for this particular purpose, the showing is still more favourable to the electric side. Especially is this true when the steam locomotive is detained on side tracks for as long a period as it takes to make the run, which is very frequently the case, since under these conditions the cost of fuel becomes a larger proportion of the total operating expense. A 2–8–0 locomotive with 50 square ft. of grate surface burns 300 lbs. of coal per hour while lying on side tracks. Reports from Mallet locomotives indicate that from 600 to 800 lbs. are burned per hour under the same conditions. The cost of a unit of power with the steam locomotive becomes relatively higher under maximum than minimum boiler demands, while with electricity the cost per unit is at a uniform rate, whether working under extreme or light power demands. For example: A consolidation (2–8–0) type locomotive with 180,000 lbs. on 57 in. drivers, 50 square ft. of grate surface, working under maximum conditions on a 1½% grade, would burn 150 lbs. of coal per square ft. of grate surface per hour and evaporate from 12 to 15 lbs. of water per square ft. of heating surface per hour. Under these conditions the cost per 1,000 ton miles would figure out as follows:

$$\frac{F \times \text{price per ton} \times R \times 1000}{2000 \times \text{m.p.h.} \times E \times TF} = \text{Cost per 1,000 ton miles}$$

where F = coal per hour (150 lbs. × 50 sq. ft. of grate surface).

R = resistance to be overcome [(grade per cent. × 20) plus 6].

E = 80% efficiency to cover losses such as cleaning fires, idle time while under steam, cylinder condensation, air pump consumption, etc.

TF = tractive force, in this case 180,000 lbs. on drivers ÷ 4·5 = 40,000 lbs.

Substituting these values, the formula becomes

$$\frac{7{,}500 \text{ lbs.} \times \$2{\cdot}85 \text{ (11s. 10½d.)} \times 36 \times 1{,}000}{2{,}000 \times 10 \times 80\% \times 40{,}000} = \$1{\cdot}20 \text{ (5s.)}$$

If the same service is handled by electric locomotives the cost on a similar basis becomes: R × (watt hr. per ton mile) × 1,000 tons × price per kw. at the rail

$$= \frac{36 \times 2 \times 1{,}000 \times \$0{\cdot}01\frac{1}{4}}{1{,}000} = \$0{\cdot}90 \text{ (3s. 9d.)}$$

If locomotive coal is taken at $1·70 (7s. 1d.) per ton, the cost for coal for locomotives under the foregoing conditions would be:

(*a*) Steam, $\frac{\$1{\cdot}20 \times 1{\cdot}70}{2{\cdot}85} = \$0{\cdot}716$

(*b*) Electric current reduced to 1c per kw. hour at the rail:

$$\frac{0{\cdot}90 \times 1\text{c}}{1\frac{1}{4}\text{c}} = \$0{\cdot}72$$

With steam locomotives the most economical average speed, for freight service, is 12 to 15 miles per hour, where there is ample track space for the free movement of trains. With a dense traffic this free movement can only be obtained by a higher speed and if the large train tonnage be maintained, more horse-power is required of the engine and boiler. It is difficult to increase the size of steam freight locomotives without resorting to the Mallet compound articulated type, and here we have the equivalent of two locomotives in one machine.

With the electric locomotive it is possible to develop a much greater horse-power and a large percentage of overload at the time when needed and do it more economically than with steam. The New York Central electric locomotive has a maximum peak horse-power of 3,000, which is 25% above normal. This maximum is about double the power which can be obtained from the New York Central Standard Altantic (4–4–2) type locomotive. Similar proportions can be obtained for electric freight locomotives and their size and power are not limited by boiler capacity. If the steam locomotive is capable of developing 30,000 tractive force at the drawbar at 12 miles per hour or

$$\frac{30{,}000 \times 12 \text{ m.p.h.}}{375} = 960 \text{ h.p.}$$

and it is required to increase the speed of the train to 20 miles per hour and maintain the same tonnage, then 1,600 h.p. will be required, which means the employment of a much larger locomotive or double heading.

INTERCHANGE OF TRAFFIC.

By George Westinghouse.

Mr. George Westinghouse dealt in his paper chiefly with the necessity for the early selection of a comprehensive electrical system embracing fundamental standards of construction which must be accepted by all railway companies in order to insure a continuance of that interchange of traffic, which, through force of circumstances, has become practically universal, to the great advantage of transportation companies and of the public. For this interchange of traffic Mr. Westinghouse postulates eight specific requirements, namely: (*a*) A standard gauge of track; (*b*) A standard or interchangeable type of coupling for vehicles; (*c*) A uniform interchangeable type of brake apparatus; (*d*) Interchangeable heating apparatus; (*e*) A uniform system of train signals; (*f*) A supply of electricity of uniform quality as to voltage and periodicity; (*g*) Conductors to convey this electricity so uniformly located with reference to the rails that, without change of any kind, an electrically fitted locomotive or car of any company can collect its supply of current when upon the lines of other companies; (*h*) Uniform apparatus for control of electric supply whereby two or more electrically fitted locomotives or cars from different lines can be operated together from one locomotive or car. Outside of economy in capital expenditure, and economy and conveneince in operation by steam or electricity, it matters not, he urged, whether each locomotive and car and the apparatus upon them differ from every other locomotive and car in size or details of construction, so long as the constructions are operative and the materials employed are used within safe limits.

Mr. Westinghouse went on to trace the development of alternating current apparatus, and traced the process by which he became convinced, in view of the limitations of the direct current system, and notwithstanding the conclusions arrived at by the late Lord Kelvin and others, that the extended distribution of electricity for industrial purposes could be secured only by the generation of alternating currents of high voltage and their conversion by static transformers into currents of various voltages. He went on to detail how, in 1892, two single-phase motors of about 10 h.p. were built by the Westinghouse Company to determine the possibilities of using alternating current for traction work. These motors were designed for 2,000 alternations per minute and about 200 volts. They were of the series type, with commutators, and had a relatively large number of poles. These were placed upon a car and tested on a short piece of track with very short curves and rather steep grades. There was a transformer on the car on which there were several taps and the voltage was varied by means of single pole switches. It was considered at that time that the system would be ideal for locomotive work, but as there were no such projects in view, no large motors of this type were built. Mr. Westinghouse then discussed the direct-current or third-rail system; the three-phase system with two overhead trolley wires and the

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single-phase, high-tension system with single overhead trolley wire, and observed that locomotives equipped with each of the three types of motors have been in successful operation, and have demonstrated their usefulness, capacity and reliability in practical railway service. The three-phase motor having a definite constant-speed characteristic is particularly adapted to certain conditions, but on the other hand it has less general adaptability to the ordinary varying conditions of railway operation. The single-phase motor has a facility of voltage control which gives an efficient means of speed adjustment, and in this particular is superior to the other systems. As to locomotive costs, the differences are in many cases more than offset by the cost of other elements in the electrical system.

Dealing with the transmission systems for direct-current, three-phase and single-phase systems were then contrasted on the basis of the number of links or elements between the power-house and the electric motor. Mr. Westinghouse said for the direct-current system these links consist of raising transformers in groups of three; a transmission line of three wires together with sub-stations which require attendants; sub-station transformers in groups of three; rotary converters for converting to direct current; third-rail contact conductor, which for heavy work must often be supplemented by copper feeders; a track return circuit which must be provided with heavy bonds and in certain cases supplemented by feeders and so-called negative boosters. Moreover, it is necessary to maintain the alignment of the third-rail within close limits, both in its distance from the track rails and its elevation above them, as the contact shoe can have only a small range of automatic adjustment. For the three-phase system the respective links are: Raising transformers in groups of three; transmission line of three wires; sub-station transformers in groups of three; two overhead wires as a contact system; a track return which usually requires nothing but inexpensive bonding. The overhead trolley wires require a double system of overhead construction, as the wires must be kept separated and well insulated from one another. They must be maintained at equal height above the track and at switches and cross-overs, as the construction is complicated. For the single-phase system the links are: Raising transformers; a transmission line of two wires and sub-stations widely spaced; a sub-station lowering transformer; a single trolley wire; a track return usually requiring only inexpensive bonding. In certain cases where the distance from the power station is not more than 15 or 20 miles, a single-phase trolley can be supplied directly from the power house, so that only one single element, namely, the trolley wire, intervenes between the generators and the locomotives. The single trolley wire permits a relatively wide range and height, as the pantagraph trolley automatically adjusts itself to the position of the trolley wire. In some cases the wire has a normal height of 22 ft. and may be carried under bridges where the limit is 15 ft.

In selecting a proper electrical system for railway operation, Mr. Westinghouse urged the prime importance of the following considerations: In the first place the electric locomotive should be capable of performing the same kinds of service which the steam locomotives now perform. This will be most readily secured by electric locomotives which can practically duplicate the steam locomotives in speed and power characteristics. This includes a wide range of performance, embracing through passenger service at different schedule speeds; local passenger service; through freight service in heavy trains; the handling of local freight by short trains; and a variety of switching, terminal and transfer movements. This naturally calls for wide variation in tractive effort and in speed, both for the operation of different kinds of trains, and also for the operation of the same train under the varying conditions usually incident to railway service. The electric locomotive should be capable of exceeding the steam locomotive in its power capacity. It should be able to handle heavier trains and loads, to operate at higher speeds, and in general to exceed the ordinary limits of the steam locomotive in these regards. The readiness with which several electric locomotives can be operated as a single unit enables any amount of power to be applied to a train. The electric system should adapt itself to requirements beyond the ordinary limitations of the steam locomotive in small as well as large things. It should be adapted for use on branch lines, and for light passenger and freight service similar to that so profitably conducted by interurban electric roads, which in many cases run parallel to steam roads, not only taking away the traffic of the steam roads, but building up a new and highly profitable traffic, both in passenger and in express service. A universal electrical system requires that power should be transmitted economically over long distances and supplied to the contact conductor. The system should utilise the most highly perfected apparatus for the electric transmission of energy and its transformation into suitable pressures for use. The contact conductor in an ideal system should be economical to construct, both for the heaviest locomotives where the traffic is dense, and for light service on branch lines. It should impose minimum inconvenience to track maintenance; should give minimum probability of disarrangement in case of derailment, or in case of snow and sleet, and should in general be so placed and constructed as to give a maximum assurance of continuity of service.

Mr. Westinghouse concluded his most interesting paper by pointing out the difficulties which will need to be surmounted in the selection of a uniform system. There will naturally be arguments in favour of one or another of the systems already in use and the inclination of those who have adopted a particular system to advocate its general acceptance. There will be others who will urge that there is room for several systems and also those who will give undue weight to some feature of minor importance instead of giving consideration to the whole system. "Were there now only one system to be considered, there would be a concentration of the energy of thousands on the perfecting and simplifying of the apparatus for that system to the advantage of railway companies and of manufacturers. I earnestly recommend to the serious consideration of railway engineers the pressing need of determining the system which admits of the largest extension of railway electrification, and of a prompt selection of those standards of electrification which will render possible a complete interchange of traffic in order to save expense in the future and to avoid difficulties and delays certain to arise unless some common understanding is arrived at very shortly."

It was remarked by Mr. Scott that Mr. Westinghouse said he would like to have someone at the meeting who appreciated his purpose and motive in preparing this paper. Mr. Westinghouse would remind them that several years ago when the question of the compulsory electrification of railways in tunnels and terminals was before the New York Legislature and about the time of certain tunnel disasters, both in America and in Europe, he advocated the use of steel cars. He was severely criticised in some quarters, but he adhered to his suggestion, and now steel passenger cars were becoming the standard for that type of service in America. At the present time Mr. Westinghouse was endeavouring to give his best thoughts from the railway standpoint to the matter of electrification and to do a future service to railways.

DISCUSSION.

Mr. H. F. Parshall, M.Am.Soc.M.E., said he thought that the Institutions were to be congratulated on the character of the papers and on the eminence of the contributors. Mr. Westinghouse was known throughout the world as a pioneer on electric traction and in traction generally. Mr. Potter's name was not so well known, principally because he was the Chief Engineer of a great organisation, but they might regard him as being probably the chief authority in the world so far as the details of electric traction installation were concerned. The other authors of the papers were also well known. Discussing the papers, he said he could not readily accept the statement that in a traction installation the controlling factor would be the transmission system. It certainly was not the case in England. The Board of Trade in this country required the most expensive form of

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transmission system imaginable. They were only allowed seven volts drop in the earth return, which meant frequent and numerous sub-stations of large capacity. For example, it would hardly be thought possible that in a line like the Central London Railway—six miles in length—they had five sub-stations. These sub-stations had a net capacity of 9,000 kw. They could not at all times comply with the requirements of the Board of Trade or of the Postmaster-General except by this arrangement. In addition, they had a storage battery which would work the entire service for a short time. These arrangements were more elaborate than would be required for a surface route, because they had to be prepared to get the passengers out of the tunnel in case of a general failure. The cost of maintaining and keeping up the rolling stock was three times that of the transmission system. In America, where sub-stations were further apart, and where they were not restricted as regards earth return, the transmission system would be a great deal cheaper. Passing on, he said it was estimated that the cost in a high transmission line for single-phase was 60% greater than for a D.C. system, the calculation being based on equal current density. He had recently been to America and inspected the New Haven system and the New York Central system. One fact, which stood out prominently, was that either system could deal with dense terminal traffic in a way that steam traffic was unable to do. But he would remind them that the New Haven system could not operate in England under Board of Trade regulations. All the safeguards they had to provide for in this country had been most studiously left out of the New Haven system! A point which came out strongly—and on which most American engineers agreed—was that for suburban work inter-urban or practically any class of work to which the motor car was applicable the single-phase was hopelessly out. In the case of the trunk line work, where the locomotive would be the main factor, there remained a good deal to be said, but, so far as this country was concerned, the single-phase system in the light of American experience was only applicable to a class of traffic that was not likely to become soon electrified. Undoubtedly there were a great many railways which would profit largely by electrification of their terminal arrangements. The controlling factor would be the capital cost. Beyond doubt, the single-phase system would not give the same acceleration and was more expensive to operate than the three-phase.

Mr. J. Dalziel, of the Midland Railway, noticed that both the English papers before the meeting asserted that main line electrification was commercially impracticable, and that suburban working might therefore be dealt with quite aside from any main line considerations. While he did not agree with this view, he considered it more reasonable than that advocating separate consideration of every case. That course, to his mind, spelt chaos. He believed that main line electric working in this country was not only commercial, but was comparatively imminent, and if that was so it was unquestionable that, other things being equal, to design to fit in with those future conditions was more important than anything else in scheming any electrifications, and that, therefore, the finding of a generally applicable all-round system was the most important traction problem of the day. Even granting that single-phase had disadvantages in suburban work, he did not see how electrification could be regarded as a narrow question of separate sections and districts. It was clear that with all the doublings and widenings that had taken place there must be lines which were approaching their maximum capacity, and where expensive methods, such as double heading, banking, and so on, were required, and that the necessary added capacity on those lines could be obtained far more cheaply by electrification than by doubling or re-grading. For example, though he made no allegation as to congestion on the lines in question, and spoke not at all for the company with which he was connected, the disparity between the relative costs of electrification and of re-grading alone without doubling on the Derby-Manchester and Sheffield-Manchester sections of the Midland main line would clearly be overwhelmingly in favour of the electrical alternative. It was true there were no water powers in this country, but there was coal of cheaper quality than could be burned on a locomotive, and, in fact, electrification schemes on those very lines were in progress in Germany, while the heavy, continuous, and mixed traffic, the large amount of shunting and terminal work, and the congestion and heavy grades of many sections and branches were factors favourable to electric methods here more than anywhere. To ignore main line work then would be to take a very serious risk of incurring future complications and retarding natural development, and, that being so, single-phase in suburban work must have drawbacks very pronounced indeed to justify its being discarded. The English papers before the meeting were adverse to single-phase, but the allegations made earlier in its history of inferior acceleration and higher power consumption for similar schedules had disappeared. There remained adverse weight and cost comparisons and unreliability. Mr. Potter's reports as to unreliability probably resulted to some extent from the double current working so largely used in America, which, by the complications it introduced, and which they hoped to avoid here, undoubtedly must reduce reliability as well as increase both cost and weight. Single-phase apparatus being new, progress in knowledge and design would assuredly reduce both weight and cost. In respect to reliability, and in particular to Mr. Carter's remarks as to the use of forced draught, he pointed out that the Midland's Westinghouse single-phase equipment at Heysham had had only four breakdowns in the 2½ years of its service, and those, being caused by failures respectively of a lightning arrester, and badly-made H.T. joint, a circuit breaker trip coil, and a motor armature, could hardly be attributed either particularly to the fact of the apparatus being single-phase or in any way to forced draught being used. With regard to efficiency, the lower single-phase efficiency was counterbalanced by the S.P. motor characteristic being better suited to heavy schedule suburban service because of its better sustained acceleration, a feature which might be accentuated by over-voltage tappings, and which increased coasting and decreased brake losses. In fact, cases in which the actual power station ourput or purchased energy for the railway were so appreciably greater with single-phase as to justify its being passed over if there was any possibility whatever of long distance extension were, notwithstanding the greater equipment and train weights, practically non-existent, and in most cases the single-phase should go in on its merits, anyhow. Taking one example only, Mr. Aspinall's Liverpool-Southport trains had a consumption of 96 watt hours per ton mile. On a similar schedule the Midland-Heysham train consumed on test 88 H.T. watt hours per ton mile with a very light train. With trains of similar accommodation the respective power station outputs would be as 1·25 D.C. to 1 A.C., the latter train being 3·8% the heavier, making no allowance for better working of the longer train. That schedule could be maintained by the A.C. train continuously. He would like to say that Mr. Carter's D.C. efficiency on Figure 5 was 93½% over all, so they must be specially good motors. He could not follow Mr. Carter's anti-forced draught remarks, as forced draught was being increasingly adopted and involved no difficulties not easily got over. Why not take single-phase motors, like other things, as they were? What he had to say on Mr. Hobart's paper hinged largely on Table 1. In the first place, the Heysham trains were not primarily designed for the service analysed by Mr. Hobart. They took occasional loadings much in excess of those given, the Midland working time-table permissible loads being 215 tons between Heysham and Morecambe, and from Morecambe to Lancaster, and 185 tons Lancaster to Morecambe. On busy days in summer the cars took four coach trains for many hours together as rapidly as those trains could be got in and out of the stations, and that service was principally between Lancaster and Morecambe, which was a shorter distance and a higher speed schedule, being less restricted by curve restrictions than in Table 1. What those coaches were fully capable of doing might be typified by the 30 m.p.h. 1·32 mile service with 88 watt hours per ton mile consumption already mentioned. Using with those the revised Siemens equipment weight he had made up another analysis of the Heysham train, bringing out the correct h.p. per ton of electrical equipment at 8·83. Those figures were available to Mr. Hobart, and could have been used. A fair comparison on actual weight of the

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schedule he had used should have been based on the Westinghouse car, the equipment of which gave an output figure of 7·2 h.p. per ton. That, however, by no means ended his criticism. As Table 1 was a comparison really of continuous output capacity and still remained one in which a forced draught motor made a worse showing than the naturally-ventilated one, it was evident there was something still wrong. As a matter of fact, there must be a mistake in the ton-mile consumption given for the Piccadilly train. By a set of simple calculations which he, the speaker, had put in, and which were open to Mr. Hobart's criticism, it was easy to show that on that input the mean current input per motor was of the order of 95 amperes, so that the root mean square current per motor could not be less than 150 to 200 amperes, or the unheard-of figure for a naturally-ventilated motor of ½ to ⅔ of the 1 hour rating. That Piccadilly consumption and that given for that schedule by Mr. Hobart in his Table 7 were entirely in disagreement with the consumption figures for that and like schedules in his own book, "Electric Railway Engineering." On pages 77 to 80, diagrams 90 and 94 to 96 of that book practically that very schedule was given as requiring only a consumption of 56 watt hours per ton mile with 32 seconds coasting, up to 72·8 with no coasting at all, that was the absolute maximum, the consumption being reduced on the track graded for acceleration and retardation to 30·7 watt hours. The Piccadilly line was described in the "Tramway and Railway World" as graded, but the question of grading was extensive. He found by observation that coasting between the shorter distance stations averaged about 38 seconds, which would therefore make the working of the line correspond, even if level, to certain no more than the above-mentioned 56 watt hours per ton mile. Giving Mr. Hobart for tunnel train resistance, which, according to his footnote, should not have much effect, an increased allowance up to 63 watt hours per ton mile, and revising his figures accordingly, his specified figure for output per ton of the Piccadilly equipment became 7·4 against the specific output of the Heysham train, already mentioned, of 8·8. Such a result was only to be expected in consideration of forced draught being in use on the latter. That corresponded to a root mean square current on the Piccadilly train of about 90 to 120 amperes, which was quite high enough.

Mr. Sidney Stone said he believed it was an admitted fact that the wear of track on electric railways in this country was excessive, more particularly on those lines in which the multiple unit system was used. He thought that on the City and South London, where electric locomotives were used, the wear was not so marked. He went so far with a friend to get out a scheme to so arrange that they could always have a predominating power on the front motor. If they must have a multiple unit system they might increase the power on the front motor so as to have an increased haulage on to the drawbar; in other words, they could keep the drawbars taut instead of slack, and thus avoid crushing up of trains.

Mr. C. F. Scott (Past President of the American I.E.E.) laid emphasis on the point that with regard to railway electrification there were no general rules. The various elements had to be considered and the problem taken as a whole. Very peculiar applications were likely to result if a general rule were applied to every specific case without modification. On the other hand, they arrived at false general conclusions if these were based on specific cases. They were apt in some of their engineering discussions on the other side to devote most of their energies to controversies as to system rather than to considerations of the general features of real application. He reminded his hearers that the literature of twenty years ago on the electric motor was very largely a comparison of relative efficiency. They all knew now that the common reason for using electric motors was, not that they might save power, but in order to efficiently use more power. In certain cotton mills the constancy of speed of the electric motors, which allowed a maximum speed to be maintained continuously, gave a gain in output which justified the cost of installation of the electric power irrespective of the amount of power used. Increased capacity of railway line at congested points by saving the double tracking or other increase in track facilities might be the great advantage of electric traction. Electrification permitted double or treble decking of rails so that the same number of tracks might be got one above the other in very much less space than is now used. Railways, instead of having rights of way of four or six tracks from suburbs into cities, might have two or three and the ground now practically wasted might be utilised for other purposes. A number of papers had made comparisons between direct current and single-phase systems. The real difference was that the single-phase equipment cost more and that the advantage in the single-phase was in the lesser cost of the line. The need of careful observation of this consideration and also of noting carefully the specific conditions on the road would be apparent if they examined some of the instances quoted in the various papers and saw the different conclusions which might be drawn from a slight change in conditions or assumptions. In Mr. Hobart's paper he found that the element of transmission, which was by some engineers recognised as the large element to take into account, certainly an important one, had almost no consideration. For general average efficiency he believed that an efficiency of some 80% for sub-stations would not be too high. Commenting on Mr. Pomeroy's paper, he held that with slight difference in assumptions and changed assumptions, which were apparently not well founded, very radual difference might be made in the final results. Concluding, he dealt with the position of the single-phase systems, and pointed out that according to an official report the operating cost per car mile of the oldest single-phase system operating in Indiana was less than that of any other road in the State. He believed that the New Haven road was the only real trunk line in America operated electrically; and it was, he thought, the only road considering trunk line service which was now proposing extensions. The New Haven road was purchasing new locomotives and devising its overhead structure for extension and that by single-phase systems.

Mr. Philip Dawson telegraphed regretting that owing to being detained at London Bridge he could not join in discussion, particularly as Mr. Hobart's fundamental data regarding elevated electric trams were, in his opinion, quite inaccurate. The weight of equipment should be 36 not 44 tons; the watt-hours per ton mile 66 not 79; and, moreover, motors were quite satisfactory to run the service. "These errors alone," wired Mr. Dawson, "vitiate all his conclusions."

Mr. Hobart observed that there were many points on which he was in very good agreement with Mr. W. Bancroft Potter. It was, however, his (Mr. Hobart's) considered opinion that the continuous current was a little lower in cost than his own data would indicate, and in the alternating current a little higher in cost. The results compared so very closely that it would not take much alteration in the figures to change the balance in favour of the single-phase system. In the case of such a road as referred to in the paper, the single-phase would be cheaper and the more appropriate—though the difference would be very slight indeed.

Mr. Angus Sinclair, M.Am.Soc.M.E., dealt with the phase of the discussion relating to extending the electrical operation of freight service. Mr. Westinghouse thought that electrical extension would gradually come, but, so far as his (Mr. Sinclair's) experience had gone with railway operating, he did not think there was the least indication of such a time arriving at all. The lesson that the railway managers of the United States had learnt from the rapid change of power was liable to influence those who had received the suggestion that electric motors should take the place of steam locomotives. The chances for electric traction for freight in the United States were, in his opinion, very slim indeed.

Mr. J. G. Wilson considered that three facts had been established. Firstly, on suburban roads of heavy and moderately heavy traction the conversion to electric traction was capable of effecting considerable reduction in working costs, even taking into consideration the extra capital outlay; secondly, electric traction on suburban roads gave the only really effective and satisfactory means of competing with other means of suburban transit; and, thirdly, there were inter-urban routes and, possibly, also cases of exceptionally heavy freight movement where the

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adoption of electric traction might offer advantages, and hold out possibilities which the improvement in the details, and electric equipment continually tended to increase. The actual progress of conversion of steam routes to electric traction was not commensurate with those facts, and it was no doubt natural that it should be so. Among the many reasons for it was there were two, at any rate, proven methods of making the conversion, supported by eminent authorities. The fact that there were different methods could not but perplex the railwaymen's minds. Mr. Westinghouse advocated a way to remove this bar to progress—the adoption of one system of electric traction and the exclusion of the consideration of all others. He was in entire agreement with Mr. Westinghouse so far that if it were practicable it would have many desirable results, but he could not escape from the conviction that it would be impracticable. And if impracticable, it was not absolutely necessary, and, further, it was not economically sound. To illustrate the force of his remarks he quoted the Great Eastern and the Great Northern Railways in London. It could be shown, he said, that the cheapest method of dealing with the suburban problem of the Great Eastern Railway was the adoption of the direct current system, but, to anyone considering the problem of the Great Northern Railway's mineral traffic it would be impossible not to take into account the claims of the single-phase system. There was the question whether one railway could give way to the other for the sake of interchange of traffic. Whereas one system could not be adopted for all cases, he held that in any individual case the cheapest and the best system could be adopted with a degree of certainty. Delaying conversion to electric traction for the sake of arriving at uniformity was not, in his opinion, commercially sound, because the advantages to be gained were remote and problematical, and the advantages foregone were real and too large to enable a railway company to afford to lose them in the meantime.

Dr. F. R. Hutton, hon. secretary of the American Society, agreed that the problem of railway electrification was of great importance, but he pointed out that the conditions in America, where there were long unbroken tangents, were quite different from those prevailing in England and elsewhere where the distances were short.

Mr. Carter in his reply remarked that the single-phase motor was dynamically suitable but would not be one that could be used unless forced draught were adopted and helped to carry off the extra heating. The continuous current motor was run at about the limit of its thermal capacity with natural cooling.

Mr. Barnes maintained that there could be no question they still had an advantage in favour of direct current.

Mr. Aspinall, in closing the discussion, insisted that the installation four or five years ago of the Liverpool and Southport Railway showed that the system such as they had was perfectly satisfactory. They had no trouble with the cars, third-rail, generating station or sub-stations: the only thing which, from the commercial point of view, wanted correction was the wear and tear of the motor machinery. Speaking as the general manager of one of the English railways, he held that no general manager could afford for one moment to close his mind to the possible utilisation of either one system or the other—whichever might prove to be commercially right. The utilisation of rolling stock to its greatest possible capacity was one of those items to which much greater attention must be paid than almost anything else. There was more money to be made under that heading than out of any of these questions of system.

Votes of thanks brought the proceedings to a close.

PERSONAL.

The Salford Town Council has promoted the Deputy Borough Electrical Engineer, Mr. H. J. Hawkins, to succeed Mr. V. A. H. M'Cowan in the borough electrical engineership. Mr. Hawkins is to receive a salary of £500 per annum, rising to £700 by annual increments of £50.

Mr. George Westinghouse has resigned the presidency of the Westinghouse Electric and Manufacturing Company, though he remains in office in connection with the other Westinghouse concerns.

EXTRACTION OF IRON FROM ORE AND PULP.

It will be remembered that we referred recently to a communication made by Mr. W. C. Brown to the South African Institute of Electrical Engineers on the difficult problem of extracting iron from gold bearing ore and pulp. Since then he has returned to the subject and giving the following sketches and particulars of a machine which he has designed and worked.

In Fig. 1 A is a cast iron core, 10½ in. long by 6 in. diam., with hollow in centre 2 in. diam. B is a circular pole, face 20 in. diam., turned perfectly flat on the top side, the under side being tapered gradually from the edge, which is ¼ in. thick to the top of the core, where it is ½ in. thick. It is secured to the core by four ½ in. countersunk screws.

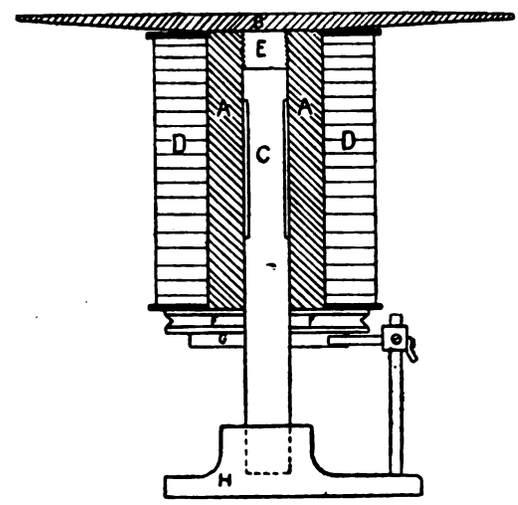

FIG. 1.

The exciting coil consists of 5,120 turns of No. 18 S.W.G. D.C.C. wire, and is wound on a bobbin made of sheet iron with brass flanges. The whole is made watertight with a zinc covering soldered to the iron bobbin. One end of the coil is grounded, and the other end brought out to a slip ring (G). Between the slip ring and core a fibre insulator (F) is placed, to which the slip ring is secured. The insulator F is grooved as shown, so that it can be used as a pulley to revolve the magnet. In the top end of the core a brass plug (E) is screwed. This serves as a bearing, and the whole is revolved on the spindle (C), which is secured in a cast-iron foot (H). The exciting current of this magnet is 2½ amps. at 100 volts, D.C. being used.

The magnet revolves at 6 r.p.m., and is driven through a worm gear by a ½ h.p. motor. A ⅜ in. cotton rope passes

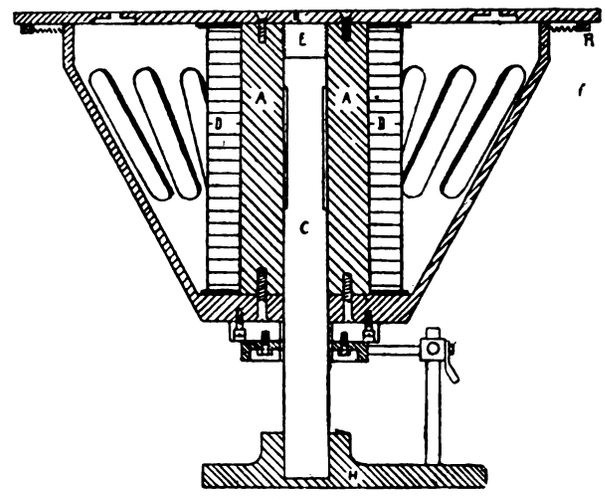

FIG. 2.

over the pulley (F) and over a grooved pulley on the worm gear, a suitable tightener being fitted to take up the slack.

The following sketch shows the position of the magnet in relation to the classifier under which it is placed.

The pole plate is at an angle of 35°. The pulp falls on the centre of the plate and flows in a widening stream to the bottom edge, which is approximately 12 in. wide by ¼ in. thick. The iron particles are all caught on the edge of the plate and scraped off by a piece of canvas belting.

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No iron of any size passes the magnet, and only the very finest is lost. This is due to the fine iron not being able to get into contact with the plate and is carried away by the heavy pulp.

The iron (much of which resembles the heads of tin tacks) is cleaned by a gentle flow of water and no sand reaches the scraper. At the scraper it flows in a steady stream at the rate of 17½ lbs. per hour into an iron box where it collects and is removed from time to time.

This magnet is placed under one of four classifiers which receive pulp from 150 stamps, the light stuff going to the cyanide works, while the heavier bodies are separated and sent to the tube mills. Placed as it is with only one-fourth of the pulp passing over it, it could not be expected to catch all the iron that comes from the mill.

This machine was only made to demonstrate that the iron could be abstracted, and a glance at figure No. 1 will show that it could be made to work with a much greater efficiency.

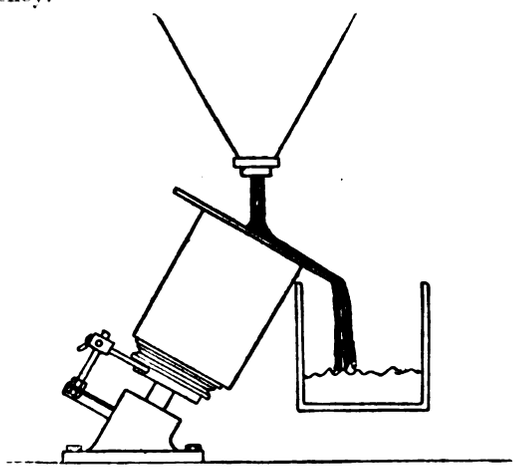

Fig. 3.

Fig. 3 shows the improvement. An outer pole casing, with ventilating holes, serves to bring the positive and negative poles in close proximity, separated by a non-magnetic metal ring ½ in. wide on the top and 3 in. wide underneath. This serves to concentrate the magnetism where it would be most useful.

A rotating magnetic table, as described, of suitable size could be placed in the main launder. Here it will work at much greater advantage, as the whole of the pulp would pass over the strongest part of the magnet twice, so that very little iron could get away.

The velocity of the stream would be reduced by allowing the pulp to spread through a bell-mouthed launder; the stream would also be thinner, and the iron more easily extracted. In this case, the power for rotating the magnet would best be applied by a small rack and gear wheel fitted beneath the outer magnet edge, as shown in sketch 3, at "R," the centre pivot serving to hold the separator steady.

CONDENSING PLANT CONTRACTS.

Messrs. Willans & Robinson, Ltd., have recently received a large number of orders for surface condensing plants, the principal of which are set out below:—One set for dealing with 100,000 lbs. steam per hour, for the East Rand Mines; two sets for dealing with 64,000 lbs. steam per hour, for Sydney Corporation; two sets for dealing with 41,000 lbs. steam per hour, for Australia; one set for dealing with 36,000 lbs. steam per hour, for Cardiff Corporation; three sets for dealing with 34,000 lbs. steam per hour, for Canada; one set for dealing with 30,000 lbs. steam per hour, for Eastbourne Corporation; one set for dealing with 30,000 lbs. steam per hour, for South Africa; one set for dealing with 28,000 lbs. steam per hour, for Belfast Corporation; two sets for dealing with 22,000 lbs. steam per hour, for Devonport Dockyard; two sets for dealing with 21,000 lbs. steam per hour, for Midland Railway, Derby; two sets for dealing with 20,000 lbs. steam per hour, for Pleasley Colliery; two sets for dealing with 17,000 lbs. steam per hour, for Baldwins', South Wales; one set for dealing with 15,000 lbs. steam per hour, for Calcutta Electric Supply Company; one set for dealing with 13,000 lbs. steam per hour, for Carlisle Corporation; two sets for dealing with 7,500 lbs. steam per hour, for Swansea Harbour Trust.

FINANCIAL NOTES.

COUNTY OF LONDON ELECTRIC SUPPLY.—The directors of the County of London Electric Supply Company, Ltd., announce an interim dividend on the Ordinary shares for the half-year ended 30th ultimo at the rate of 4% per annum, less income-tax, payable 2nd proximo.

* * *

CHELSEA ELECTRICITY SUPPLY.—The directors of the Chelsea Electricity Supply Company, Ltd., announce an interim dividend of 4% per annum (2s. per share), less income tax, on the Ordinary shares for the half-year, payable September 15.

* * *

STRATFORD-ON-AVON AND MIDLAND JUNCTION.—The directors of the Stratford-on-Avon and Midland Junction Railway recommend a dividend at the rate of 1½% per annum on the ordinary stock for the half-year, carrying forward £756. A year ago the distribution was at the rate of 1% per annum, carrying forward £1,400.

* * *

LIVERPOOL OVERHEAD RAILWAY.—The accounts for the past half-year show an available sum of £9,593, out of which the directors recommend the payment of dividends at the rate of 5% per annum on the Preference shares, carrying forward £5,917. A year ago only the dividend on the 1892 Preference shares was paid.

* * *

DUBLIN UNITED TRAMWAYS.—Out of an available balance of £45,191 a dividend at the rate of 6% per annum for the half-year, less income-tax, has been declared on the Ordinary and Preference shares, £4,000 has been set aside towards the renewals of the cars, leaving £7,291 to be carried forward.

* * *

LIVERPOOL OVERHEAD.—The accounts of the Liverpool Overhead Railway Company for the past half-year show an available sum of £9,593, out of which the directors recommend the payment of dividends at the rate of 5% per annum on the Preference shares, carrying forward £5,917. A year ago only the dividend on the 1892 Preference shares was paid.

* * *

DUBLIN AND LUCAN ELECTRIC RAILWAY.—After providing for payment of debenture interest, the directors propose the payment of 5% dividend on the Preference shares for the six months ended June 30, carrying forward £612.

* * *

HOVE ELECTRIC LIGHTING.—The directors of the Hove Electric Lighting Company, Ltd., have declared an interim dividend on the Ordinary shares at the rate of 8% per annum for the half-year to June 30. They have also ordered the payment of the full interim dividend on the Preference shares, due September 1, at the rate of 5% per annum, for the same period.

ELECTRIFIED LEAD MINE.

The members of the Cumberland branch of the Institute of Mining Electrical Engineers visited Troutbeck, near Windermere, at the invitation of Mr. W. H. Borlace, manager of the Glenridding Lead Mines. This particular mine is equipped throughout with electrical appliances, the power for generating the current being obtained from water turbines. The mine is a drift in the mountain side, and the party were conveyed to the "in bye" for 1¼ miles by electrical motor, which conveys all the material to the surface. Here a shaft—75 fathoms deep—was descended by means of electric winding plant, the party examining the different methods of blasting and extracting the lead ore. The return was by the underground electric railway. The pumping machinery and washing plant proved of exceptional interest.

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UNITED STATES: Mr. E. Brandon, 27, Thames Street, New York.
CANADA: Messrs. Walsh & Stoer, Stair Building, Toronto.

IMPORTANT NOTICE TO ADVERTISERS.

Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents and Small Advertisements by 9 a.m. on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements, 24 words 1s. per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

Situations Vacant, 24 words 1s., three insertions 2s. 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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THE ELECTRICAL ENGINEER *can be had by order from any Newsagent in Town or Country, and at the various Railway Stations; or it can, if preferred, be supplied direct from the Office on the following terms:*

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Other Places	5s. 6d. ..	10s. 6d. ..	21s. 0d.

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Cheques, Post Office and Postal Orders for Subscription and Advertisements should be made payable to "THE ELECTRICAL ENGINEER," LIMITED, 149, Fleet Street, London, and be crossed.

Bound volumes of* THE ELECTRICAL ENGINEER, *containing half year's copies, bound in Dark-Blue Cloth, Gold Lettered, price 8s. 6d.

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COLONIAL MARKETS.

While the most hopeful sign of the reviving prosperity in the electrical industry is the demand for machinery and appliances for work at home, the renewed demand for British manufactures abroad is very marked and welcome. Partly due to a generally distributed rising wave of prosperity, this overseas seeking after our goods, often at an enhanced price compared with Continental-made articles, is largely the result of the greater care and determination that have characterised our engineers of late. Although we are still behind some of our competitors in certain lines of investigation (frequently often initiated in this country), as reference to our patent list columns will show, yet there has been an awakening, and attention has been paid to neglected fields. As a case in point, we may mention the manufacture of telephone apparatus, which has long been practically abandoned to Americans and Scandinavians, but which has now been taken up most successfully in our midst. So, too, though in a lesser degree, with instruments of precision. It is, however, in the bigger machines and appliances of more general use that progress has been most marked, if not in principle at least in perfection of detail; and, happily, we have kept up the high quality of material and workmanship. This tells in the long-run, and we see where cost is not the primary factor a very notable leaning towards British manufacture among overseas buyers. Naturally enough, this is most marked with our Colonial brethren, who, when loyalty to their own native manufactures is not in question, prefer British made articles. Something of sentiment there is in this, but in the main it is a matter of choosing the best to be had for money or for the object in view. In dealing with our overseas brethren, however, it is wise to remember that local needs and prejudices should be studied and liberally met. Let us consider Canada. We have there a vast country, naturally wonderfully rich, being developed by

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earnest, determined people, only partly of our own blood. The country has special needs and limitations. While electrification of traction and industrial plant is far more general than with us, with them hydraulic generation is the rule. Now, British manufacturers are placed to some disadvantage with American competitors, because in the United States much the same conditions prevail as in Canada, and the problems of transport are easier. Moreover, American agents are to be found all over the Dominion, seeking for orders and studying local needs, and thus we often see big Canadian contracts which cannot be taken up in Canada itself going across the border into the States. Happily, many of our own manufacturers have either branch works, or well-equipped agencies over there, and more are now following the example set. Canada is bound to receive an impetus shortly, which will mean a rapid accession development. It is well to be prepared for this. Then, again, we have South Africa. Severely handicapped in the Transvaal and Rhodesia owing chiefly to financial manipulations, there was perhaps a tendency to look upon the vast sub-Continent as electrically lost to us. Happily, grit has told its usual tale; perseverance has not only enabled us to keep our footing, but to increase our foothold. To-day there is a distinct desire for British enterprise, and it is notable that African colonists have been over here, mainly from Natal, but also from the Transvaal, with a view to study British electrical engineering and seek out the best outfits for the great electrical enterprises that are to be initiated over there. While as a rule such enterprises will take the form of hydraulic generating stations, steam raising by means of comparatively poor coal, or even by refuse destructors, are also being considered. Apart from these big concerns, there is the general trade in electrical appliances that is well worth considering. We learn from visitors that electrical contractors are prospering fairly well in South Africa, and are looking more and more to Great Britain for supplies. Many instances of visits from these contractors to England for the purpose of inspection, purchase and opening up agency communications, have come under our notice of late. But, again, here a close study of local conditions is necessary. This applies still more forcibly as regards Australasia, where, as in Canada, we have to reckon with a determined effort to foster local manufactures, and in the second place, in the absence of home-made articles, to seek the best for money value. The more slowly-developing but huge industrial field of India is another locality requiring particular study. Wherever we look, in fact, there are most alluring prospects, alluring because of the evident bent towards electricity, prospects which can be materialised by a display of foresight, energy, and missionary work. The engineer commercial traveller able to preach the excellence of British articles and to report on local limitations and prejudices, in default of local branches, is the most pressing need of the present and the immediate future.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 152, Fleet Street, London, E.C.

CONTRACTS.

LANCASHIRE ASYLUMS BOARD.

COUNTY ASYLUM, RAINHILL.

The Committee of Visitors of this Asylum are prepared to receive tenders for the manufacture, supply and delivery F.O.R. at Rainhill Station (L. and N. W. Rly.) of Telephone Apparatus and Cable, consisting of Main Central Battery System Metallic Circuit Telephone Switchboards, complete with Indicators, Plugs, cords, Bells, Relays, Batteries, etc., together with Telephone Instrument Sets, and the necessary Dry Core Paper Insulated Cables and Wires.

Specification and full particulars can be obtained on application to the undersigned.

Tenders must be delivered at my Office not later than 5 p.m. on Thursday, August 25 next, endorsed "Telephone Apparatus and Cable."

The Committee do not bind themselves to accept the lowest or any Tender.

(By Order),
JAS. GORNALL,
Clerk and Steward.

Clerks Office,
Rainhill Asylum,
July 29, 1910.

TENDERS FOR INSTALLATION OF WIRELESS TELEGRAPHY within the DOMINION of NEW ZEALAND.

General Post Office,
Wellington, May 23, 1910.

Tenders indorsed "Tender for Installation of Wireless Telegraphy within the Dominion of New Zealand" will be received by the Minister of Telegraphs, General Post Office, Wellington, up to noon of December 15, 1910, for the supply and erection at the following places of installations of wireless telegraphy in accordance with Specification and General Conditions:—

(1.) At or near Doubtless Bay.
(2.) At or near Gisborne.
(3.) At or near Cape Farewell.
(4.) At or near Sumner, near Christchurch.
(5.) At or near Bluff.

Specification and General Conditions and "Form of Tender" may be obtained at the office of the Superintendent of Electric Lines, General Post Office, Wellington; the office of the High Commissioner, 13 Victoria-street, London; and also from

(1.) Messrs. R. W. Cameron & Company, 23, South William-street, New York, U.S.A.;
(2.) H. Stephenson Smith, Esq., 244, California-street, San Francisco, Cal.

Tenders must be made out on the "Form of Tender," and must be accompanied by a deposit or receipt for a deposit as required by the General Conditions.

Deposits on tenders must accompany the tenders in the form of a bank draft, or the deposit may be banked. The banker's certificate must be forwarded with the tender, but it must be approved by the High Commissioner, London; or by

(1.) Messrs. R. W. Cameron & Company, 23, South William-street, New York, U.S.A.; or by
(2.) H. Stephenson Smith, Esq., 244, California-street, San Francisco, Cal.;

and must be to the effect that the amount of the deposit is held at the call of the Minister of Telegraphs.

Tenderers must state the name of the country in which the apparatus, etc., will be manufactured.

The Minister of Telegraphs does not bind himself to accept the lowest or any tender.

Tenders must be addressed to the Minister of Telegraphs, General Post Office, Wellington, New Zealand. If sent by post they must be prepaid and be registered.

J. K. LOGAN,
Superintendent of Electric Lines.

CONTRACTS OPEN.

HOME.

CHELMSFORD.—Borough Education Committee invite alternative tenders for (1) supplying and fixing wiring for lighting by electricity; (2) supplying and fixing pipes for lighting by gas, at the Trinity-road Council School. (Particulars from Mr. W. H. Pertwee, architect, The Institute, London-road, Chelmsford.) August 31.

DUBLIN.—The Technical Committee of the Corporation invite tenders for the installation of electric light, etc., at the Technical Schools, Bolton-street, Dublin. (Particulars from the Corporation Electrical Engineer.) August 9.

DUNDEE.—Town Council.—45 tons steel rails. (Specifications, City Engineer, 91, Commercial-street.) August 8.

EDINBURGH.—H.M. Office of Public Works.—Electric lighting of Holyrood Palace. Estimate, £6,300.

LONDON.—The County Council invite tenders for the wiring and fitting for electric lighting of the second portion of the central car repair depot, Woolwich-road. Particulars (40s.) from the Clerk of the Council, County Hall, Spring-gardens, S.W. This amount will only be returned if a *bona-fide* tender is submitted. August 30.

LONDON, S.W.—London County Council.—Wiring and fitting second section of Woolwich-road car repair depôt. (Specifications £2, County Hall, Spring Gardens, S.W.) August 22.

MANCHESTER.—Corporation.—Sale of scrap rails, metals. (Particulars, General Manager, 55, Piccadilly.) August 9.

NEWPORT.—Corporation.—Annual supply of carbon filament electric lamps (British made), radiator lamps (British made), flame arc carbons for Excello and Oliver types of lamps, alternating and direct current two-rate and prepayment meters. (Specifications, 10s., to Borough Treasurer, Borough Electrical Engineer and Tramways Manager.) August 15.

OLDHAM.—Corporation Tramways.—Material and labour, except electrical equipment, for construction of new tramway in Rippendon-road. (Specifications, £1 1s., Borough Surveyor.) August 17.

RAINHILL.—The Lancashire Asylums Board invite tenders for supply and delivery of telephone apparatus and cable, consisting of main central battery system, metallic circuits and telephone switchboard complete. (Particulars from the Clerk, Rainhill Asylum, Lancs.) August 25.

SALFORD.—Corporation.—500 tons steel tramway rails. (Specifications, General Manager, 32, Blackfriars-street.) August 15.

SOUTH SHIELDS.—Corporation Tramways.—Hand-operated travelling crane. (Particulars from Corporation Electrical Engineer.) August 8.

OVERSEAS.

BRISBANE.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up to noon on September 7, for the supply of (1) glass cells, corks and tubes, and porous cups for batteries (Schedule No. 120), and (2) battery material, chemicals, etc. (Schedule No. 121). A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications, etc. may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

LORENZO MARQUES.—Harbour and Railways Board.—One 10-ton and 75-ton electric cranes. (Particulars, 9 milreis gold, General Stores, Harbour and Railway Board, Lorenzo Marques, or Agency of Caminhos de Ferro de Lorenzo Marques, Johannesburg, or Direcçao dos Caminhos de Ferro Ultramarinos, Lisbon.) English translation, 4·5 milreis gold, from Caixa Geral dos Depositos, Lisbon, or from the Johannesburg or Lorenzo Marques authorities above indicated.) September 5.

MOSTAR.—Municipality. Electricity works. (Particulars from Chief Magistrate.) October 1.

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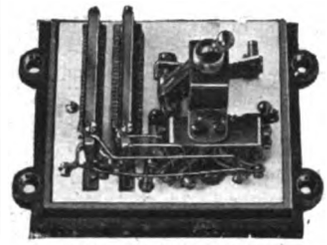

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CONTRACTS—continued.

CORPORATION OF DUBLIN.

INSTALLATION OF ELECTRIC LIGHT, ETC., IN THE BOLTON STREET TECHNICAL SCHOOLS.

The Technical Education Committee of the Corporation of Dublin are prepared to receive Tenders for the Installation of Electric Light, etc., in the Technical Schools situated in Bolton-street.

Specification, with General Conditions and Form of Tender, can be received from the City Electrical Engineer, Fleet-street, Dublin, on and after Friday, July 29, 1910, on payment of ten shillings and sixpence for each Specification, which will be returned on receipt of a bona-fide Tender. The plans may be inspected in the Office of the Clerk of Works, at the New Buildings, Bolton-street.

Tenders, addressed "Chairman of the Technical Education Committee, Lower Kevin-street, Dublin," and marked "Tender for Electrical Installation, Bolton-street Technical Schools," to be delivered not later than noon on Tuesday, August 9, 1910.

The Contract will be subject to ratification by the Municipal Council.

The Committee do not bind themselves to accept the lowest or any Tender.

(Signed), LOUIS ELY O'CARROLL,
Secretary.

July 28, 1910.

City of Dublin Technical Education Committee, Offices, Lower Kevin-street, Dublin.

APPOINTMENTS.

UNIVERSITY OF BIRMINGHAM.

ASSISTANT LECTURER AND DEMONSTRATOR IN ELECTRICAL ENGINEERING.

The Council invite applications for the above appointment.

Candidates must be Graduates, and must have had at least one year's employment in a responsible position in the test room of a first-class electrical engineering firm. Candidates with experience in lecturing will be preferred. The successful candidate will be required to superintend the students' work in the electrical engineering laboratories, and to assist the professor in tutorial classes.

Stipend £150 per annum.

Applicants should state age, training, and previous experience, and should send in their applications, accompanied by copies of testimonials (not originals) on or before September 17, 1910, to the undersigned, from whom further particulars may be obtained.

The appointment and stipend will date from the 1st October next.

GEO. H. MORLEY, Secretary.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

ASSISTANT EXAMINERS IN THE PATENT OFFICE (20-25). *September 1st.*

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the Secretary,

CIVIL SERVICE COMMISSION,
Burlington Gardens,
London, W.

BUSINESS WANTED.

ESTABLISHED FIRM of ELECTRICAL CONTRACTORS in provincial town desires to PURCHASE, as a going concern, small established Electrical Contracting Business in Manchester, with good-class connection and capable of development.—Apply, Box 85, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

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WANTED, Competent Electrical Engineer Draughtsman, thoroughly conversant with Motor Car Construction. Give experience, references and salary required. Box No. 52, c o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

ST. PETERSBURG.—Municipality.—Commutator switchboard tables for telephone exchange extension. (Particulars from Telephone station, Morskaja, 22.) August 15.

THE HAGUE.—Colonial Office.—Tramways in Batavia and railways. Estimate, £120,000.

TRIPOLI (SYRIA).—Municipality.—Electric tramways.

WELLINGTON, NEW ZEALAND.—Tenders will be received by the Minister of Telegraphs, General Post Office, Wellington, New Zealand, up to noon on December 15, for the supply and erection of installations of wireless telegraphy at or near (1) Doubtless Bay, (2) Gisborne, (3) Cape Farewell, (4) Sumner, near Christchurch, and (5) Bluff. A deposit will be required with each tender. Copies of the specifications, conditions, and forms of tender may be obtained on application to the office of the High Commissioner for New Zealand, 13, Victoria-street, London, S.W. Copies may also be obtained by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

WINNIPEG.—Board of Control.—40,000 ft. of 13,000V 3-core cable. (Specifications, Power Engineer, Carnegie Library Deposit, $100. September 1.

TENDERS ACCEPTED.

HOME.

BECKENHAM.—Urban Council, for electrically wiring Alexandra Schools, £202, Oscar Jones & Company.

BRIDLINGTON.—The Town Council have accepted the tenders of the British Westinghouse Electrical and Manufacturing Company, Ltd., for the supply of metallic filament lamps, and of A. Sidney & Company for the supply for one year of Bentley Smudge Coal at 9s. per ton delivered at the works.

LONDON (—County Council.—Supply of low-tension cables, cable boxes, etc., at the Central Car Repair Depot. Western Electric Company, Ltd., North Woolwich, E. (accepted), £948 14s. 2d.; Johnson & Phillips, Ltd., Old Charlton, £979 12s. 2d.; W. T. Glover & Company, Ltd., Manchester, £1,004 9s. 2d.; Siemens Brothers & Company, Ltd., Westminster, S.W., £1,011 12s.; W. T. Henley's Telegraph Works Company, Ltd., Blomfield-street, E.C., £1,016 2s. 7d.; British Insulated & Helsby Cables, Ltd., Prescot, £1,053 0s. 1d.; Callender's Cable & Construction Company, Ltd., Victoria Embankment, E.C. £1,053 4s. 6d.

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MISCELLANEOUS.

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ESTABLISHED FIRM of ELECTRICAL CONTRACTORS in provincial town contemplating opening a branch in Manchester or purchasing small established Electrical Business there, wish to enter into negotiations with a young, energetic man as REPRESENTATIVE. Applicants must have practical experience in the business and, preference would be given to one having a thorough knowledge of estimating and possessing a local connection among Consulting Engineers, Architects, and principal business houses.—Apply, stating age, experience and remuneration required, Box 80, c/o. THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

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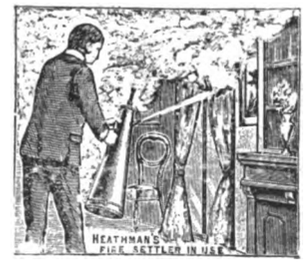

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There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

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SESSION 1910-11 COMMENCES ON TUESDAY, OCTOBER 4.

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Electrical Engineering	David Jardine Professor : E. W. Marchant, D.Sc., M.I.E.E.
Lecturer in Electrical Machinery	T. K. Catterson-Smith, A.M.I.E.E.
Civil Engineering ..	Prof. S. W. Perrott, M.A.I., M.I.C.E.
Naval Architecture ..	Prof. W. S. Abell, R.C.N.Cret., M.I.N.A.
Engineering Design and Drawing	Lecturer : J. Wemyss Anderson, M.E., M.I.C.E., M.I.M.E.
Mathematics	Professor F. S. Carey, M.A.
Physics..	Lyon Jones Professor : L. R. Wilberforce, M.A.
Inorganic Chemistry..	Grant Professor : E. C. C. Baly, F.R.S.
Railway Engineering..	Associate Professor : J. A. F. Aspinall, M.E., M.I.C.E., P.I.M.E.
Municipal Engineering	Associate Professor : J. A. Brodie, M.E., M.I.C.E., M.I.M.E.
Municipal Electrical Engineering	Associate Professor : A. Bromley Holmes, M.E., M.I.C.E., M.I.E.E.
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Session 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

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THE ELECTRICAL ENGINEER, 149, FLEET STREET, LONDON, E.C.

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CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so

AIRDRIE: Town Hall, to cost £10,000.

BINGLEY: West Riding Education Committee. Addition of Engineering Block, Gymnasium, Baths and Laundry to the new Training College.

BOURNEMOUTH: Corporation and H.M. Office of Works. New Law Courts, at a cost of £20,000.

CHISWICK: H.M. Office of Works, Storey's Gate, S.W. Telephone Exchange.

DARTFORD: The Kent Education Committee propose building a Girls' Secondary School at a cost of £8,000.

MACCLESFIELD: Willink & Thickness, architects, 14, Castle-street, Liverpool. Erection of Grammar School.

WATFORD: Guardians invite tenders for the erection of Children's Home.

NOTES.

Revolving Table.

An automatically revolving table, worked by electricity, has been brought out by Messrs. T. H. Brooker & Company, for the display of goods in shopwindows, etc., and is worthy of being noted by contractors. It revolves two or three times per minute, thus giving ample opportunity for observation of the goods displayed. The gear is driven by a small electric motor, which can be plugged into an ordinary lampholder, and will run all day at a trifling cost and practically without attention. The gear wheels being specially manufactured, run smoothly, and almost without noise. The motor and gear being enclosed in a strong box—which can be hidden—the danger of fire is eliminated, and there is no fear of delicate dress fabrics, etc., being damaged by entanglement in the mechanism. The table is capable of useful adaptability. The bottom shelf is secured to the revolving spider, and on this can be placed a dress stand or anything of a similar kind; or a tier 4 to 5 ft. high of four or five shelves decreasing in size, can be fastened to a central column; or the central column can be supplied with brackets carrying a number of hooks, rods, shoestands. The price ranges from £7 10s.

Medical Appliances.

Messrs. Siemens Brothers & Company, Ltd., have issued a series of illustrated pamphlets dealing with medical electrical appliances. Supplement No. 9 to Catalogue No. 506, "The Skiafix," describes an apparatus which is a simple and inexpensive fixing and holding device for securing the head and all the parts of the body during X-Ray treatment, in any desired position. It should meet a long-felt want, in that in the majority of cases it entirely supersedes sand bags, pillows, straps and other inefficient methods of holding, involving considerable trouble and time in their arrangement. Supplement No. 4 to Catalogue No. 506, "X-Ray Outfits with Rotating High Tension Rectifiers," supersedes the one of similar title dated April, 1909. It describes and illustrates new and improved patterns of these modern X-Ray outfits, which we claim are superior to any other similar form of outfit now on the market. Supplement No. 10 to Catalogue No. 506, "Universal Electro-Medical Apparatus," describes an apparatus which has been designed as a result of their long experience in connection with medical applications of electricity for cautery, faradisation, galvanisation, galvano-faradisation, light, etc. It combines all these applications in a handy and portable form, its chief qualification being that it is entirely earth free. Catalogue No. 530, "Tantalum Dental Instruments," These instruments are made of pure tantalum metal with the usual steel handles. They are particularly suited for certain specific dental purposes on account of the fact that they are not affected by any reagent met with in dental practice, being attacked by only one acid, namely, hydrofluoric acid. In consequence, they may be used for all silicate cements without being affected by the cements or staining them, as is the case with steel instruments. In addition, they are very hard and sufficiently elastic to enable them to be made fine enough to penetrate into difficult positions, which is not the case with agate and ivory, as frequently used for silicate cements.

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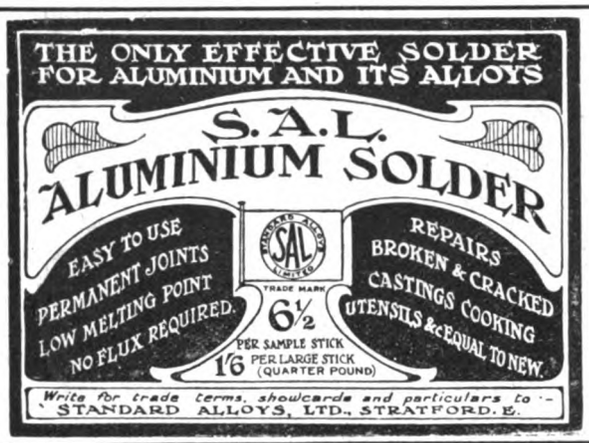

UNITED RIVER PLATE TELEPHONE.

At the 24th annual ordinary general meeting of the United River Plate Telephone Company, Ltd., Sir Irving Courtenay (chairman and managing director) said: The company has made excellent progress during the year; subscribers have increased, revenue has increased, the service, we believe, has improved and is improving, and by the end of the present year—by which time we expect all our principal exchanges in Buenos Ayres will have been turned over from magneto to common battery working—we are satisfied that our service will compare favourably with that of any European city. The new common battery boards, several of which are now working, have been of the most material assistance. These changes, of course, necessitate a great deal of other work before the boards can come into use. For instance, existing overhead installations have to be taken down and new distributors connected to our underground plant; but, as far as possible, all this work has been proceeding contemporaneously, and the present year should see the bulk of it completed.

As showing the progress which the Argentine Republic is making in all directions, we find that the same telephone problems met with in Buenos Ayres have already arisen in other cities, and thus we are engaged in erecting a common battery board with a suitable building in Bahia Blanca, where, as I mentioned last year, we have put part of our plant underground; and as a like provision will require, before very long, to be made in Rosario, we have taken the opportunity, when installing a new sub-exchange in the city, to anticipate the conversion of the main exchange, and this sub-exchange will be on the common battery system. We have opened new exchanges in Florencio Verela and Monte Grande, two important and growing suburban towns to the south of Buenos Ayres, and in Maipu on the Dolores Mar del Plata line. I mentioned last year that we were making arrangements for constructing a line to Mar del Plata, which has been described as the Brighton of Argentina. As the authorities were anxious that this line should be ready for last season—the season comprises the months of December, January and February, when Mar del Plata is at its fullest—our people strained every nerve, and, in spite of many difficulties, they completed this line of about 250 miles in what I should think is record time for such an undertaking. The Azul line, to which reference was also made in last year's report, has enabled us to tap an important district in the centre of the Province of Buenos Ayres, a line which will be carried right through to Bahia Blanca.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

It is occasionally necessary for electricians to be reminded that electricity in mines has to be treated in a very much more stringent manner than in an ordinary factory. Two cases of trouble which have occurred recently in the Tyneside area of the Northumberland and Durham coalfields are worth putting on record as illustrating the difficulties. The first is that of the electrocution of a deputy at the Bessy Drift, Blaydon Burn, belonging to the Priestman Collieries, Ltd. Owing to the recent railway strike, which dislocated mineral traffic, the colliery had been laid idle, and the deputy with some lads was leading water from the workings. A telephone bell began to ring and the report in the local press states that the deceased man took hold of the receiver and immediately received a fatal shock. This illustrates the leakage danger in colliery practice, if the incidents have been correctly reported. The other incident had, fortunately, no serious result except to the perpetrators. Two putters at the West Mickley Colliery went into the motor room of the colliery and interfered with some of the switchgear, which resulted in a short circuit, blowing the fuses locally and also bringing out the automatic switch at the generating station and shutting down the whole plant. This emphasises one of the points which was raised repeatedly in the debates of the Association of Mining Electrical Engineers last winter—the framing of rules, and of means of carrying these into effect, whereby no untechnical man shall interfere with electrical machinery.

Wireless Communications by the Mercantile Marine.

The attention of local steamship owners has been drawn to the provisions of a suggested bill concerning the means of communication between vessels at sea by means of wireless telegraphy. The points of chief interest are that British or foreign-owned vessels carrying passengers, or carrying fifty or more persons including crew, are to be equipped with transmission and receiving apparatus capable of operation by day or night over a distance of 100 miles. A penalty of £1,000 for evasion is proposed. This bill is now under consideration by Mr. James Knott, M.P., and Mr. W. J. Noble, as a sub-committee of the North of England Steamship Owners' Association, for the purpose of forming a resolution embodying such objections to the Bill as this Association may make.

Tramway Topics.

Electrical tramway engineers who are contemplating following the lead of Newcastle in charging for parcels carried on the cars should sit "tight" until they have made a thoroughly definite division between those parcels which may or may not be carried free. The interpretation of a chargeable parcel by the conductors of the Newcastle cars has apparently varied within wide limits, with the result of protests in the papers and even on the Tramways Committee. One letter in the local press states that pennies were charged for dinner baskets and empty letter bags, while in the Tramways Committee one gentleman bewailed the fact that he had been threatened with proceedings because he had refused to pay for his golf bag. Working men are also in revolt concerning the charge which is being made for their kit bags, and it has therefore been decided by the Tramways Committee to give the matter their further consideration. In the meantime the Corporation Tramways Committee at Sunderland have been approached with the object of getting them to allow passengers on the cars to carry their dogs with them. The Sunderland tramway magnates have very wisely declined this form of parcels-carrying.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

Birmingham claims the credit for what promises to be an important development in wireless telephony and telegraphy specially applicable to moving trains and other vehicles. The inventor is Mr. Hans Von Kramer, of Witton, near Birmingham. Mr. Kramer, who is still a young man, has been interested in electrical research for some fifteen years past, and in his home workshop at Erdington has made a series of experiments in the application of the principle of induction. Lately he has succeeded in reproducing sound-waves through a wall six feet thick. He then conceived the idea of establishing telephonic communication between a moving vehicle and a stationary point. There would have to be a stationary circuit and a travelling circuit, but without any brush contact between the two. In his garden he fixed a line from one tree to another, the end being connected with a telephone in the dining room. Carrying about with him a coil and telephone, he was able while walking backwards and forwards to transmit speech to and from the stationary instrument. Transferring his experiments to the works at Witton, he attached a frame coil to a motor car, while a wire laid along the ground was connected with a telephone in a distant part of the works. While the car was travelling at forty miles an hour clear telephonic communication was carried on between its occupants and the stationary telephone.

Successful Experiments.

After some further experiments, Mr. Kramer obtained from the directors of the London and Brighton Railway permission to try his invention upon a moving train. The trail was made last week. A frame coil, sixty feet long was attached to a Pullman coach; two wires were laid between the rails, and the stationary circuit was connected with a signal-box at Three Bridges, about half-way between London and Brighton. Mr. Kramer travelled in the guard's van, where a telephone in connection with the train coil was installed. Some trouble had been predicted from induction between the apparatus and the ordinary telegraph and telephone circuits, and in some preliminary experiments before the trial on the train this had been experienced, but Mr. Kramer devised an arrangement of crossed wires which proved successful in counteracting these disturbing influences. With the train travelling at express speed satisfactory induction was kept up, without any brush connection, between the coil on the train and the stationary circuit, and clear and continuous telephonic communication was kept up with the stationary instrument through the trial. All the electrical impulses set in motion by the act of speaking, in fact, were fully collected. Telegrams dictated from the train were despatched to Birmingham and other distant towns, and some of them were delivered before the train had reached Brighton. Having regard to the disturbances with which ordinary wireless transmission would have to contend in such circumstances, and to the delicacy of telephonic impulses, it seems likely that the application of telephony to moving trains will be achieved more speedily and successfully by methods such as Mr. Kramer has devised.

Mechanical Engineers Meeting.

The American and British Mechanical Engineers, during their stay in Birmingham last week, were afforded, by means of the arrangements made for visits to various works, many opportunities of witnessing the progress made in the district in the utilisation of electricity. Both the Birmingham and the Aston Corporation Electricity Works were thrown open for inspection by the visitors, as well as the principal exchanges of the National Telephone

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Company and some of the works in the district devoted wholly or partially to electrical engineering—among them those of the General Electric Company, Witton; and the British Thomson-Houston Company and Willans and Robinson, Rugby. Visits were also paid to a number of manufactories in which electrical power plant, in some cases quite recently, has been installed.

B. S. A. Works.

Among the latter are the works of the Birmingham Small Arms Company. In the various shops of the Gun and Cycle Department at Small Heath are three and a half miles of main shafting, and twenty-six miles of belting, driving a total of 6,300 machine tools. The motive power for the whole of the machine shops of the Gun Department, and part of the Cycle Department, is supplied from a central power-house, containing six sets of gas engines coupled direct to electric generators supplying a total of 1,100 kw. of d.c. at 500 volts, or very nearly 1,500 h.p. The remainder of the power is obtained from thirteen gas engines of various powers conveniently placed in the cycle machine shops and equal to about 600 h.p. in all, while a few high-speed steam engines, equal in all to about 600 h.p. supply the power for lighting, plating, polishing, etc. The gas for all the engines, as well as for the hardening furnaces, is made on the premises, in quantity equivalent to 3,250 h.p., in eleven Dowson generators from anthracite small coal about the size of beans. The stamping and drop hammers are worked by steam.

Other Works.

Among the other factories in which electricity is employed are the Birmingham Paint and Varnish Works (Docker Brothers), where there are a number of electric motors and electric lighting throughout, and the Saltley Works of the Metropolitan Amalgamated Carriage and Wagon Company. The hydraulic press shop of the latter, 190 ft. by 114 ft., is served by a 5-ton electric traveller, while the steel underframe shop has five electric cranes, of from 30 cwt. to 10 tons capacity, and 23 motors of 350 h.p. In the machine shop all driving is done electrically, there being ten motors of 290 h.p. In view of the discussion last week upon high-speed steel tools and electric driving, it may be noted that nothing but high speed steel is used here. The power-house, which is situated in the centre of the works, has four 250 kw. shunt wound machines, made by the General Electric Company, direct-coupled to triple-expansion Belliss and Morcom engines running at 480 r.p.m. There is also a 60 kw. Silvertown Belliss set for week-end lighting loads, the works being lighted throughout by electricity. The output of the power plant last year exceeded 2½ million units. The switchboard, made by the India Rubber, Gutta Percha and Telegraph Company, mounted on a gallery at one end of the station, is of the usual panel type, with overload and no-load circuit breakers on the generator panels and overload breaker on the main feeders, eight in number, which convey the current to the different departments. Among the machines driven by electricity some of the most interesting are those to be found in the saw mills; for instance, the Wadkin universal woodworker double-ended tenoning and cross-cutting machine, besides the usual saws, etc., all being driven by 58 enclosed motors aggregating 1,051 h.p., fixed for the most part in the cellar together with the shafting and belts. The saw in the log-mill is driven by a 50 h.p. motor at 550 revs. mounted directly on the saw spindle. These, as most other departments, are fitted up with electric cranes and travellers, whilst the wagon-building and car body shops are served by a 50 ton electric traverser 70 ft. long, carrying three tracks of different gauges. Over 550 arc lamps are in use, in addition to other forms of electric lighting, and the power installations embrace a total of 156 motors of a rated horse-power of 2,362.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Professor Mithammer has published in the "Journal für Gasbeleuchtung und Wasserversorgung" some pregnant remarks in reference to supply tensions, meaning the tensions at which the current reaches the lamp, motor, etc. He points out that they should be so chosen as to combine as far as possible economy of installation, efficiency and the life of the lamp. The first point to consider is that the cost of the distributing mains varies roughly inversely as the square of the supply tension, and the Professor, recalling that years ago the former usual tension of 65 volts was replaced by one of 110 volts, recommends that the latter in its turn should be abandoned in favour of a minimum of 150 volts. 150 volt incandescent lamps, whether with carbon or metallic filaments, are distinctly superior to 220 volt lamps in price and life. Moreover the copper conductors cost about 45% less with 150 than with 110 volts. Arc lamps with open arc can be arranged three or four in series with a 150 volt current, and enclosed lamps, two in series. The Professor proposes then to replace the present tensions of 110, 220, and 440 volts, by 150, 300, and 600 respectively.

The Economic State of German Electric Stations.

The "E.K.B." publishes some interesting results on this subject. At the end of March, 1909, there were 2,050 electric generating stations in Germany which supplied about 1,250 million kw. hours, of which 40% were used for lighting, 45% for driving stationary machinery, and 15% for railways. At the same time 6,600 million kw. hours were supplied by private concerns for their own use, 85% of which was used for power. This shows that the cost of transmission to a distance is still a factor of preponderating importance. The total capital invested in 1908 of these undertakings was about 57 millions sterling. 52% of this amount was concerned with 55 only of the concerns, all of which were in towns of over 100,000 inhabitants. The average gross profit obtained was 10%, but varied from 6½% to 12%. The higher profits always belonged to the larger towns, of which 86% exceed 8%.

Mountain Electric Locomotives.

Morgenthaler describes the electric locomotives used on the electric railway of the Wengern Alp, which have to haul three passenger coaches up banks of 1 in 6, and two up banks of 1 in 4 at 5 miles an hour. The gauge of the line is 32 in., the locomotive weighs 16½ tons, and each coach 14 tons. The h.p. at the motor axle is 300. The working part of each locomotive weighs 8 tons and is driven by a continuous current of from 1,500 to 1,800 volts. The motors are two in number, each giving 150 h.p. at 750 r.p.m.

Mine Electric Locomotives.

Some interesting results showing the economy realised in such cases by the employment of electric traction have been achieved by the electric locomotives supplied by the Felten and Guilleaume Lahmeyer Werke A.G., for Van der Heydt & Company, at Saarbruck. The mineral railway belonging to the firm is at present only about 2½ miles long, but it is intended to make it twice as long; the gauge is 27 in. The locomotives have two driving axles worked by spur gearing by a 7½ h.p. motor, the maximum speed being nearly 70 miles per hour; powerful brakes have been provided. The accumulators can be quickly taken out for re-charging, as in drawing 25 trucks, they must be re-charged every 6 miles. The replacement of the exhausted accumulators and the others only takes two or three minutes. The charging itself takes 2½ hours. The saving on the horse-traction formerly employed is very striking. Horse-traction cost 22·8 pfennig per 52 tonnen kilometer, while electric traction costs 6 pfennig per 175 tonnen-kilometer. Of the 6 pfennig the cost of current represents one pfennig only.

New German Electric Station.

The town of Gablonz, in Bohemia, has bought the electrical works of Mahla Hoffmann & Company, and has found them insufficient, although they are only about 20 years old. The Corporation has decided, therefore, to erect a new station, deriving power from the Neisse. Over a certain stretch of that river, water-mill owners and other users of the power have been bought out or otherwise got rid of. The new station will contain two turbines with horizontal axles, each giving 130 h.p. There will also be

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steam engines and steam turbines, and the total h.p. will be 260 from water, 1,820 from steam, and 520 from accumulators. The cost will be two million K., and the plant is being provided by the Austrian Siemens Schuckert Werke.

Company Affairs.

Among the electrical firms starting with small capitals are the Jason Gluhlampenfabrik, G.m.b.H., with a capital of 20,000 marks, the Deutsche Elektrizitats-Sicherung Centrale, G.m.b.H., with a capital of 25,000 marks; the Elektrizitats, G.m.b.H., fur Gross-Berlin vorm Bunger; the Deutsche Elektrizitatsgesellschaft, A.G., of Munich, with a somewhat larger capital, 150,000; the Elektrische Strassenbahn Rahnsdorf-Woltersdorf G.m.b.H., with 20,000 marks; and the Sirins-lampen Vertrieb, G.m.b.H., of Cologne, with 30,000 marks. Whatever may be the outcome of these new undertakings they prove clearly that the conditions are so favourable as to encourage attempts on the part of small capitalists to get their share of the spoil, which would not be made were there not some prospect of success. The smallness of the capital proposed negatives any idea that these concerns are not straightforward.

A limited company has just been floated in Hamburg under the name of Wasserkraft Anlagen, with the object of erecting an electric station at the mouth of the Elbe, to be worked by tidal action according to patented processes. 340,000 square metres of land have been bought near Groden for the erection of the power station which, it is hoped, will supply both Groden and Cuxhaven with light, and also work an electric railway.

The Land und Seekabelwerke A.G. Koln Nippes made a net profit of 491,787 marks for 1909 (515,024 for 1908), but pays the same dividend of 8% on the capital of 5¼ millions as for the previous year. The carry over is diminished from 70,300 to 51,278 marks, and the directors' fees from 23,427 to 21,220 marks. It should be mentioned that the net profits above stated do not include the carry-overs from the previous year.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Nearly £25,000,000 sterling are to be expended on the extension of the New York Electric Subway System and tenders are to be called for early in September next for work estimated to cost about $70,000,000—roughly, £14,383,550 sterling. The new work, including extensions to the existing electric lines involves the construction of a four-track line from Times Square through Seventh Avenue and West Broadway to Liberty Street, with a two-track extension to the Battery and a two-track branch from the intersection of Liberty Street and West Broadway under Liberty Street and the East River to Pineapple Street in Brooklyn; from Pineapple Street in Brooklyn to a junction with the existing Brooklyn subway on Fulton-street, and a four-track extension from the terminus of the Brooklyn subway at Atlantic and Flatbush-avenues, under the latter thoroughfare and Eastern Parkway as far as Nostrand-avenue. An east side four-track line from about Thirty-fifth-street under Park-avenue and private property to Lexington-avenue, through Lexington-avenue across the Harlem River to some point below East 149th-street. A two-track extension from that point connecting with the existing West Farms branch of the subway. Another two-track extension running up Mott-avenue and 153rd-street to River-avenue, with an elevated two-track line structure through that thoroughfare and Jerome-avenue as far as 194th-street. The city is to take all net profits for the first five years from the time of beginning operations on any portion of the new subway extensions. The net profits after five years are to be equally divided between the city and the Interborough Rapid Transit Company. The net profits to be determined by making the following deductions from the gross revenues in the order named: (a) maintenance of equipment; (b) maintenance of way and structure; (c) cost of conducting transportation; (d) general and administration expenses; (e) taxes, if any; (f) the actual annual charges of the company for carrying the cost of equipment and providing a partial sinking fund of three-fourths of 1% per annum to meet obsolescence; (g) interest on bonds issued by the city to defray cost of construction, plus 1% per annum as a sinking fund. If the gross revenue should at any time be insufficient to meet the gross expenses above, the annual deficit is to be made good by the city.

Electrical Trade Revival.

All over the States the electrical industry is booming. Factories are hard put to it to execute orders and overtime is being worked everywhere. The "Electrical World"—generally rather conservative than otherwise in matters of this kind—is beginning to look forward to crossing the line of the highest record of three or four years ago. Certainly the official trade figures justify an optimistic outlook. The export of heavy electrical machinery for May, 1910, was $684,938 as compared with $479,951, a noteworthy gain in a department where even as late as April there had been retrocession. But in electrical instruments and apparatus the increase is most cheering. In May, 1910, the amount of value was $1,025,549 as compared with $539,424 in 1909, a gain of practically 100%. When the two items are put together, May, 1910, shows a total of $1,710,487 as compared with $1,019,375, a gain of about $700,000. Nor is this all. The figures of the 11 months for the two items put us back near the high line of 1907-8. The gross showing is as follows: 1908 a total for 11 months of $14,168,207; for 1909 a total of $11,261,894; and for 1910 a total of $13,253,600. One significant fact, says the "World," seems to emerge from all these data, namely, that the prosperity of our electrical export trade depends now upon a greater variety being given to it. Thus the export of electrical instruments in 1910 for the 11 months was $7,791,539 as compared with $6,332,485 in 1908—a gain of nearly $1,500,000; whereas the export of heavy goods is nearly $2,500,000 below what it was in 1908. The great gain in miscellaneous goods is full of encouragement; and while we have no means of checking off the nature of the goods, it can only be inferred that there is a growing heterogeneity of product in demand abroad, or rather in Canada, Mexico and Brazil, which represent over $4,500,000 out of the $7,791,539 and are steadily increasing their purchases.

Electricity in Mining.

A valuable contribution to the technical literature of electricity as applied to mining has been made by Mr. W. S. Meyers in the shape of a paper dealing with practical experiences, which was read at a recent meeting of the West Virgina Coal Mining Institute. Mr. Meyers' conclusion is that in the application to work inside the mine there is no form of energy which compares to that of electricity. With regard to tractive power, Mr. Meyer observes that it has been the practice of mine locomotive builders to ascertain from the prospective purchasers the operating conditions at the mine for which the locomotive is intended and to equip it with motors just sufficient to meet the given loads with the maximum allowable temperature rise. In his view a much better plan is to build them regardless of mine conditions with motors large enough to withstand the severest treatment. The rule is to increase the size of the trip up to the point where the drive wheels begin to slip. The locomotive motors should have a combined output of from 10 to 12 h.p. per ton of weight based upon an hour rating at a maximum temperature rise not to exceed 75° C. above air temperature. Motors having a combined capacity under these limits will be liable to heat excessively under heavy loads, and with a greater capacity there arises the disadvantage of having to run too long a time upon resistance with medium and light loads, resulting in diminished economy. He goes on to point out that in connection with electric haulage there is no feature of importance which receives so little attention as that of rail bonding. In the mine, light springy rails, soft roadbed, insufficient number of ties, the large number of wheels passing over the joints, loose fishplates, corrosive mine water, and absence of good light are some of the drawbacks which often cause the expenditure of large sums for copper feeders and then experience heavy drops in voltage because the electric fluid has to force its way back to the generator through a lot of high-resistance bonds. If these bonds are

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placed outside the fishplates they are apt to be broken or loosened, and if placed under the plates they are usually held as in a vise destroying their flexibility and life.

The Proper Voltage.

In regard to voltage, Mr. Meyer urges that, considered from the point of economical production the higher the voltage the better, but from the safety of the men and live stock, the reverse condition applies. The voltage is in some installations fixed at 250 and in others at 500, the former requiring four times the outlay for copper in comparison with the latter, capacity and distances being equal. Fatalities of authentic record from 250 volts are very rare. Where voltages of 500 are used there have been recorded a few deaths due to electric shock. In mines of large output the difference between the 250 and 500-volt systems in cost of copper may amount to $8,000 or $10,000, and if, upon opening up a 500-volt mine, this sum were set aside and added to the usual amount allowed for mine timbering and ventilation, it is safe to predict that the decreased number of fatalities from falls in roofs and explosions would much more than offset the number due to contact with live wires. "Our state legislators," says Mr. Meyers, "should hesitate long before passing laws limiting the voltage in mines to 250, but laws compelling stringent and efficient inspection of all electric lines and appliances inside the mines should be enacted and enforced. In manways and other parts of the mine much frequented by men and live stock, the feeder wires, if there are any, should be placed in a groove mined out in the rib about two feet above the pavement." With regard to the question of a central plant or local plants, Mr. Meyers unhesitatingly declares in favour of the central plant both from the point of view of economy and that of efficiency.

The Capacity of Plant.

The capacity of the central station can with safety be placed at about 75% of the aggregate peak load requirements of the mines served, for the reasons that the peak loads seldom or never occur simultaneously, and the load factor per unit can be maintained much better in the central station, with a corresponding betterment in economy. The installation of a small direct-current plant is justifiable where electric power is required for two or three fair-sized mines in a territory in which there is no existing central plant. One such plant may serve two or three mines within a radius of about one mile from a plant having a voltage of 250, or about three miles from a 500 volt plant. In plants of 500 kw. and larger it is always advisable to install two or more units rather than one large one, even if one of the units is a spare one, in order to provide against complete shutdowns, and for better economy at light loads. In plants having a capacity of 1,000 kw or more the tendency is to install water-tube boilers with a working pressure of from 140 to 175 pounds, and a brick stack will usually figure the cheapest and best in the long run. Where the hand-fired boiler plant is too large to be handled by one fireman, automatic stokers will usually effect a saving, especially if the coal can be deposited in the bunkers without the use of complicated machinery. Three-phase, delta-connected generators and motors are almost invariably used in such plants with a frequency of either 25 or 60 cycles. If the longest transmission line is eight miles or less, 300 kw. may be delivered at the end of the line composed of three No. 6 copper wires without the use of transforming apparatus in the power station, and motor generators may be employed at the sub-stations on moderate-length transmission lines, doing away entirely with the use of transforming apparatus. In mines where a direct-current voltage of 250 is in use and in which the working district is at a considerable distance from the mine mouth, a great saving in copper can be made by placing the ordinary sub-station equipment inside the mine in the centre of the working district, carrying the alternating-current transmission wires overland to and through a bore hole leading to the underground substation. Where practicable, this sub-station should be located near a large mine pump or electric hoist in order that one attendant may serve both stations. For driving mine pumps, small fans, and other machinery, where constant speed and extended periods of operation are required, alternating-current motors of the induction type are generally more economical and more reliable than are direct-current motors, and can be operated without increasing the load upon the sub-station equipment.

Units and Symbols.

Commenting on the new suggestions put forward by the German Committee on units and symbols, the "Electrical World," referring to the question of thermo-mechanical equivalents, expresses the opinion that the recommendation that the value of the gram-calorie at 15° C. shall be taken as 4·189 joules, or 427·2 kgm. is likely to meet with very general recognition. It is pointed out however, that certain recent researches have indicated the joule and watt to be short of their theoretical C.G.S. value by 0·03%, or 1 part in 3,300. This discrepancy, if it is confirmed, applies to the practical ampere-volt-ohm system as a whole, and is a physicist's question rather than an engineer's question. In the days of the B.A. ohm, this discrepancy was admittedly much greater. "The second proposition is the substitution of the name Siemens for the mho, as the unit of conductance. The electrical unit names thus far officially adopted at international electrical congresses are nine in all—ohm, ampere, volt, watt, joule, coulomb, henry, gauss and maxwell. Two of these are German, two French, three English, one Italian and one American. It is desirable that both Siemens and Kelvin should be added to this list, in recognition of the great services of both these eminent workers in electricity. It is, however," continues the "World," "a pity to apply these names where they are not needed when there exists a demand that is likely to increase for names of other electrical units now nameless. The Germans desire to use Siemens for what is already generally known as the mho, and to replace by an effort of memory what takes no effort at present. The British also desire to use Kelvin for what is already generally known as the kw.-hour, and to replace something that does not require to be learned—something self-understood—by something to be learned with an effort. This may be magnificent, but it is not war, in applied science. On the other hand, we need names for units of electrostatic flux, flux-density, and other quantities in electrostatics that at present are neglected for want of christening. These quantities will probably insist upon being recognised and talked about in the future when new burdens on memory must be imposed." The "World" adds that a valuable contribution on symbology is appended by the committee in which a systematic development of decimal multiples and sub-multiples is propounded, and warmly applauds the proposition that, as far as possible, symbols for units should be chosen with a view to subsequent international adoption. This contribution to symbology is worthy of careful study by electrical engineers in all countries. "A useful distinction is offered between the symbol for a gram, or any of its multiples, as a unit mass, and as a unit gravitational force, by appending an asterisk in the latter significance. As a minor criticism it may be pointed out that two atmospheres are defined, namely, the technical atmosphere of 1 kg* per square centimeter and the so-called physical atmosphere of 76 cm mercury at 0° C. We think the latter should be referred to as the standard barometric atmosphere. The standard physical atmosphere should be 1 megadyne per square centimeter, as already used internationally in many physical books and pamphlets, and as recommended by the International Bureau of Weights and Measures."

Current Items.

The Sierra & San Francisco Power Company, which supplies electricity for operating the system of the United Railroads of San Francisco, has authorised an issue of $6,500,000 in bonds, the proceeds to be used for the purpose of enlarging its plant and extending its service. The company has purchased the entire power system of the United Railroads and has entered into a contract for a term of 44 years to supply the latter with energy to operate its railways. The company proposes to expend $1,000,000 during the next three years for the construction of a distributing system in San Francisco and elsewhere.

By September the plant at the Barker Meadow dam near Nederland, Col., will be ready to supply power to the

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tungsten mining district. There are at present four tungsten mills in this district and two more are now in the course of construction. The dam, which is across Boulder Creek, will be 180 ft. in height, 300 ft. in length and 140 ft. thick at the base; backing up a lake about 350 acres in area. It is estimated that 25,000 h.p. will be generated by the plant when complete.

A $3,000,000 deal concluded at Harrisburg Pa. has resulted in the consolidation of two large public service corporations that had been rivals for six years, and marked the beginning of a movement for the purchase of other large corporations and their consolidation. Emmet Queen, of Pittsburg, engineered the deal, purchaing the Harrisburg Heat, Light and Power Company and the Paxtang Electric Company. The price paid was $3,000,000.

Extensive and very valuable deposits of tungsten manganese ore containing upwards of 70% of tungsten have been discovered in Blue Grouse, near Loon Lake, Washington.

Sceptics with regard to electric automobiles should confer with Dr. A. E. Evans, of Columbus, Ohio. He bought from the Studebaker Company in April, 1905, one of their 1903 models and has used it continuously in his practice ever since. He has covered with it a distance of 87,715 miles in all sorts of weather and has never had the slightest trouble with it.

In the New York "Electrical World" of July 14, there is an illustrated article descriptive of the generating station of the Westminster Electric Supply Corporation in Horseferry-road.

In connection with Buffalo's third Industrial Exhibition which opens on October 3, preparations are being made for electric illuminations on a colossal scale. Broadway will be a lane of light during the entire exposition season. In a general way the plan for the illumination calls for an elaboration of the system of searchlights used in New York during the Fulton-Hudson celebration. Those were used to throw upon jets of steam the picture of the Clarmont. In a similar way it is proposed to portray with a bank of searchlights extending across the street from the Broadway arsenal, sketches of a buffalo, representing the city, and pictures showing Buffalo as it is expected to look 25 years hence. The searchlights will throw a dazzling light up Broadway all the way from the arsenal to Main-street and will bring into high relief the Soldiers' Monument and the buildings on the west side of Main-street. So brilliant will be the illumination that one will be able to read a newspaper anywhere along the street. The plan calls for an arrangement, also, whereby the lights can be switched from side to side, in zigzag fashion, along the street and toward the zenith, producing the effect of an aurora borealis.

The "monorail" in suburban New York, whose first trip was marked by an accident in which twenty persons, including Howard Tunis, the inventor, were injured, must not be confused with the gyroscopic monorail. The car was not fitted with a gyroscope. It runs on a single rail, but it is held in balance by twin guide rails hung overhead between pillars and lateral braces. While the car was running 30 miles an hour, one of these guide rails worked loose and the car tilted 40°, piling the frightened passengers in the lower angle. The pillars at each side of the car prevented it from toppling over utterly and the brakes brought it to a stop before worse damage was done.

The Western Union Telegraph Company created a tremendous sensation by suddenly cutting off its wire services to a number of brokerage firms in two cities in Pennsylvania and eight cities in New York State on the ground that the firms were doing "bucket-shop" business. The boycott, however, only lasted 24 hours, the firms affected claiming that they were legitimate brokers and threatening reprisals in the Courts.

Portable telephones, to be installed on the passenger trains of the Lehigh Valley Railroad, will make it possible for the train crew or passengers to get into communication with the rest of the world at any isolated point along the road. A series of experiments which have recently been carried on have demonstrated the practicability of this service. By means of an extension pole which can be hooked over the telephone wires running parallel to the track, it will be possible to make connection at any point. It is thought that this will be especially valuable in preventing delays in freight service. On passenger trains it is intended to use the telephone for the accommodation of passengers as well as the train crew, the sending and receiving of messages to be allowed while the train is waiting at a station. Plans are now under way to instal telephone dispatching circuits throughout New Jersey and Pennsylvania for a total length of 337 miles. It is the intention of the officials to equip the entire road with the telephone dispatching system as soon as possible.

EDUCATIONAL.

CIVIL SERVICE COMMISSION.

An examination for Assistant Examiners in the Patent Office (age 20 to 25) will be held in the Autumn. The latest date for receiving applications to sit (to be sent in on forms to be obtained from the Secretary of the Civil Service Commission), is September 1.

CITY AND GUILDS OF LONDON INSTITUTE.

The programme for the Session 1910-11, Department of Technology, is a portly volume of over 350 pages, giving much useful information, concisely put, and sold for ninepence. Apart from the electrical engineering courses, there are special courses in electro-metallurgy, electric wiremen's work, telegraphy and telephony.

UNIVERSITY OF GLASGOW.

The programme of classes is now published. The course in electricity is given by Dr. G. E. Allan, at twelve on Wednesdays and Fridays, the fee being three guineas. In electrical engineering Mr. J. S. Nicholson takes Class I., at 8 a.m. on Mondays, Wednesdays and Fridays, and Class II. at the same hour on Tuesdays, Thursdays and Saturdays, the fees in each case being two guineas. The fee for laboratory work is three guineas, the laboratory being open daily from 9 to 5. It may be mentioned that the equipment of the electrical laboratories includes a 30 kw. three-phase generator, and a 7 kw. two-phase generator, both motor driven, two 9 kw. rotary converters, two tramway motors mounted for experimental work, a 5 kw. continuous current motor generator or booster, a 5 kw. balancer set, and motors of various kinds for continuous and alternating current. The electrical plant in other parts of the James Watt Laboratories also provides subjects for experiment. These include a 34 kw. de Laval steam turbine dynamo, a 30 kw. high speed engine and dynamo, a 35 h.p. Eddy current brake, an electrically driven lift, and motor-driven fan, air pump and centrifugal pumps. The instrument room is equipped with the most modern measuring instruments.

UNIVERSITY OF LIVERPOOL.

The Session opens in October, the Autumn Term being from October 4 to December 16, the Lent Term from January 10 to March 24, and the Summer Term from April 25 to July 8. The electrical staff consists of the David Jardine Professor, Dr. E. W. Marchant, M.I.E.E., and the assistant lecturer and demonstrator, Mr. J. K. Catterson-Smith, A.M.I.E.E. Course B comprises lectures on D.C. machinery and electrical distribution, on Tuesdays and Thursdays, and laboratory practice on Fridays. The fee for one term is £3, for two terms, £5, and for the course, £6. Course C comprises lectures on A.C. and electrical machinery on Wednesdays and Fridays, problem classes on Tuesdays, and laboratory practice on Tuesdays. The fees are: One term, £4 10s.; two terms, £6 10s.; the course, £8. A Course A on electrical measurements is to be given during the Summer Term. The third year's (final) course comprises: Engineering, strength and elasticity of materials, dynamics and kinematics of machines, hydraulics; heat engines and refrigerators; workshop practice. Electrical Engineer, Course C, as above. Engineering design and drawing, design and drawing of complete machines and structures. Mathematics, elementary infinitesimal calculus, with applications to analytical conics.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ALDERSHOT.—The Urban electricity undertaking, upon which £28,288 has been spent on capital account, had a turnover of £4,650 during the past fiscal year. The expenditure was £2,580, and after providing for interest and sinking fund, the net balance was £335. The income shows an increase of £480.

BALLYCLARE.—The Urban Council are entering into an arrangement with Messrs. Curran Brothers, of Belfast, for the supply of electricity in the town and the lighting of the streets.

BATH.—For the year ending March 31 last the Electricity Department had a revenue of £19,651, of which £13,948 was for sale of current to private consumers. The total expenditure was £10,459. There was, however, a deficit, a debit balance of £1,660 from the previous year being wiped out by drawing upon the suspense fund, while a further amount was also taken from the reserve fund to meet the deficiency.

BECKENHAM.—The accounts of the District Council electricity works show a debit balance of £251, less £120 brought forward, so the loss for the year was £131. This is due to law and Parliamentary charges, which ammounted to £142. There is a proposal to lower rates for tradesmen using electricity for lighting purposes.

BRADFORD.—Two new 3,000 kw. Curtis steam turbines and alternators by the British Thomson-Houston Company, installed in City Electricity Works are now in active service. At the inaugural luncheon, Mr. T. Rolls, City Electrical Engineer, predicted that soon practically every mill in Bradford would be driven by electricity. The balance-sheet for the year ending March 31 shows that the profit has reached the sum of £7,399, as compared with £2,146 in the preceding year. The income has amounted to £113,983, as against £110,243, an increase on the year of £3,740. On the other hand, the working and administrative expenses have been less than in the previous year by £1,284. The interest and sinking fund charges have totalled £55,736, as compared with £55,966 in the previous year, a decrease of £230. The increase in income has been almost entirely due to current supplied for power purposes and to bulk supply consumers, and it is hoped that the further reduction in charges recently made to such consumers will enable the department to obtain a number of new connections, and that the revenue for the current year will be thus still further increased from this source.

BRIGHOUSE.—The Town Council, who take electricity in bulk for distribution, have entered into a new arrangement with the Yorkshire Electric Power Company, as follows:—For supply to power-users connected or to be connected to the Corporation's existing direct current system, the amount to be deemed at 67 h.p., a flat rate of ¾d. per unit; the amount of current sold for power purposes being ascertained from the readings of the consumers' meters. For units used in balancing, ¾d. per unit. For all other current, 1¼d. per unit. If the total charge ascertained as above exceeds the charge of the sliding scale in the existing agreement, the account will be rendered on the lower basis. These terms were accepted, provided that they shall apply to all energy taken by the Corporation from the company on the direct current system up to a maximum of 250 kw. Arising out of these recommendations it was resolved that a supply of electrical energy for power purposes, at 1d. per unit, be offered to any person within the town who will undertake to consume at least 5,000 units per quarter. At the same meeting it was decided to grant the Yorkshire Power Company permission to lay cables through Brighouse, partly in conduits and partly overhead, for the supplying of Sowerby Bridge.

BRISTOL.—For the year ending March 25, the City Electricity Department had a gross revenue of £79,572, to which had to be added refund on income adjustment £2,345, and transfer from "redemption and sinking fund" £96. But £22,082 was required for interest, £22,102 repayment instalments, and £3,109 for reserve for renewals, so there was a deficit of £2,029 on the year's trading, which was met out of unappropriated balances in hand. After making this deduction, these balances are left at £4,041. It should be stated that £798,108 was borrowed on capital account (of which £183,207 has been repaid), and £12,055 has been contributed out of revenue. There has been a slight increase of current sold. Mr. H. Faraday Proctor reports that the load factor fell from 17·23 in 1908–9 to 16·22, but in spite of this the cost of production has been again slightly lowered.

CANTERBURY.—A proposal for lighting the workhouse by electricity is being considered. Meanwhile the gas company have been granted permission to instal three meters in order to measure separately the gas consumed for (1) lighting, (2) cooking, (3) heating.

HANLEY.—Six tenders were submitted for the supply of half-a-mile of low tension distributing cable; lowest, Connolly Brothers, £147; second lowest, British Insulated and Helsby Cables, Ltd., £158 15s. 4d. It was resolved that the Electrical Engineer obtain a sample length of 220 yards of cable from Messrs. Connolly Brothers, lay and test same, and report thereon at the next meeting of the Committee.

LONDON: BERMONDSEY.—The Finance Committee of the Borough Council are manifesting uneasiness over the Electricity Department, whose gross profits for the past year amounted to £10,765, yet the net profit after paying interest and sinking fund charges was only £43. The cost of production has been reduced from 6d. to ·52d. per unit, and there is an increasing sale of current. The current year's profit is estimated to come out at £660 in spite of an increased expenditure of £900. It is alleged that electricity is sold too cheap.

LOUGHBOROUGH.—Some busybodies have been questioning the right of the Municipal Electricity Committee supplying motors, but the local Act specifically allows this trading.

MAIDSTONE.—The Urban electricity undertaking had an income of £13,281 for the year ending March 31, and the expenditure was £7,624. Out of the gross surplus of £5,656 there had to be disbursed £2,312 interest on loans, and £3,294 repayments of capital. The deficiency of £101 was met out of the unappropriated surplus of previous years, which is still left at over £1,070. It has been decided to apply to the Local Government Board for powers to borrow £4,000 for extensions of mains.

MIDDLESBROUGH.—It appears that for the quarter ending June 30, the municipal electricity undertaking had a revenue of £3,556, which is £545 more than the corresponding period of last year. Certainly a fine showing, and one that augurs well for the future prosperity of the concern.

NORWICH.—The sewage electric pumping station at Eaton is now in full working order, placing this output of the borough into direct communication with the main sewerage, and so adding enormously to the sanitary conditions at little cost.

SOUTHEND.—Mr. H. R. Hooper, Inspector of the Local Government Board, held an inquiry into an application for permission to borrow £20,467 for electricity extension purposes. He strongly criticised the proposal to borrow £1,000 for meters, and £1,000 for street lamp brackets. After discussion it was agreed to borrow £9,200 for a sub-station at Chalkwell Park, £3,245 for a sub-station at Thorpe Hall, £4,022 for mains, and £4,000 for services. It is not proposed to increase the machinery at the Central Station (although the total capacity is 2,075 kw. as against an average demand of 1,679), but storage batteries will be installed at the sub-stations, and there will be charged during periods of slack demand, thus keeping the generating plant working at full load.

OVERSEAS.

BUDAPEST.—The Municipality have been negotiating for some time past with a view to taking over the remainder of the concession of the two great electric supply companies of that city, and so to municipalise the electrical supply. It appears now that no agreement could be reached, and that the Municipality are consequently considering a project for the erection of a third electric power supply establishment, which would be under municipal control.

COPENHAGEN.—The Municipal Lighting Department are considering tenders for one year's supply of D.C. cables.

MONTREAL.—The City Council have decided to place all electric cables, with the exception of trolley lines, underground. Powers have been obtained to raise five million dollars to carry out this work.

RIO DE JANEIRO.—The British Acting Consul-General (Mr. E. Hambloch) reports that, according to the "Jornal do Commercio" of June 28, in view of the excellent results that have attended the trials of wireless telegraphy on the Madeira-Mamoré Railway, the Minister of Public Works has been authorised by the President of the Republic to receive proposals for the installation of radiographic stations (Marconi system) in the three prefectures of Acre. The Acting Consul-General adds that there may or may not be a public call for tenders in this connection.

ST. LAMBERT, QUEBEC.—By a vote of the ratepayers the Monarch Electric Company has been freed from all municipal and water rates for a period of 21 years.

TORONTO.—The Imperial Trade Correspondent (Mr. F. W. Field) reports that a firm of wholesale confectioners at that place, who are extending their plant, may require electric motors. The name and address of the firm may be obtained by British firms on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

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TRACTION.

HOME.

BOLTON.—Mr. Arthur A. Day, general manager of the Corporation Tramways, reports for the past year a revenue of £121,707 (an increase of 2·42%), while the expenditure was £72,436 (an increase of only 1·09%). The net balance was £23,074 (an increase of 5·99%), while the amount available for reduction of rates was £7,866 (an increase of over £1,700). It is to be noted that the general repairs and maintenance charges have dropped from 1·545d. to 1·517d. per car mile, general expenses from ·717d. to ·669d., and traffic expenses from 2·655d. to 2·581d.

STOKE-ON-TRENT.—The Borough Council have appointed a Committee to wait upon the Tramway Company and urge that the tramway cars should be improved, their condition being considered very unsatisfactory.

OVERSEAS.

ROME.—The Direzione Generale delle Ferrovie dello Stato have prepared a project for the electrification of 890 kiloms. (about 553 miles) of the Italian State Railways. For this end, a hydro-electric plant, capable of supplying a current of 40,000 volts, would be set up near the river Wuocken.

VIENNA.—Tenders will be opened on August 7 at the Directorate of the Austrian State Railways, for the establishment of an electric generating station at Pardubitz.

COMPANIES' MEETINGS AND REPORTS.

COLLIERY PUMPS.

Sir George White, Bart., presiding at the annual meeting of the Main Colliery Company, Ltd. (Neath), held at Broad-street, Bristol, stated that they would have felt the increased cost arising from the working of the Eight Hours Act more severely in the making up of the profit and loss account for the year had it not been that for six or seven months of the period they had the advantage of a considerable saving arising from the new electrical pumping equipment having been put to work. The use of the electrical plant had been confined principally to the pumping at Nos. 1 and 6 pits, but, as the installation was capable of doing twice the amount of work which was now being performed, they would be extending the scheme by carrying cables to the other pits and utilising electric power there also for pumping, ventilation and other purposes, and that ought to be done without any considerable further capital outlay, so effecting economies by displacing a number of isolated steam plants at the several collieries.

LANCASHIRE ELECTRIC POWER.

At the annual meeting of the Lancashire Electric Power Company and its affiliated company, the Lancashire Power Construction Company, held in London, the chairman (Dr. H. F. Parshall) said that the business of the Company had progressed so that it was estimated that the rate of the trading profit was now £5,000 per annum. The growth of the connected load was fairly satisfactory. During the past year it had been increased by 1,750-h.p., or 150 per month. The average customer was about 200-h.p., and the bulk of the business was done with the cotton trade. There was something like 1,800-h.p. contracted for, but not connected. The whole of this would be connected during the present year. The new load was largely in connection with the coal-mining industry. In addition to this, there was the usual growth in other branches of industry. It was satisfactory to note that the price per unit had increased during the year due to their being able to get contracts at a better price. During the year £13,115 had been invested in the Power Company, and of this £9,315 had been spent on distribution to supply the increase of load, and £3,000 had been spent on the new power-house. He gave figures which, he said, indicated a high degree of efficiency both as regarded the generating plant and the operating staff. £800 had been spent on Parliamentary expenses, and this had proved satisfactory expenditure, because they had been able to secure that local authorities which sought to operate within their area of supply were not to be allowed to do so without obtaining their sanction. Owing to the action taken by the Radcliffe Council and the report of the Local Government Board, the company felt warranted in promoting an electric lighting order for the district. They did not get the order, but the Board of Trade intimated that unless the conditions in the Radcliffe district were improved they would listen more favourably to another application later on. Under the circumstances, the directors had hopes that they would be able to enter upon satisfactory relations with the Radcliffe Council, who were not able to supply power at reasonable terms. How great the field was might be seen from the fact that the power used within the immediate district of the company's station was over 100% of the company's connected load.

COMPANIES REGISTERED.

BOURNEMOUTH ELECTRIC THEATRE COMPANY, LTD.—£6,000, in £1 shares (3,750 Preferred, and 2,250 Deferred). Business: To acquire freehold hereditaments and premises No. 25 and 27, Commercial-road, Bournemouth, subject to payment of mortgages for £6,500. Private company.

BRACUHY FALLS AND METALLURGICAL SYNDICATE.—£48,000 (£1). Concessionnaires, promoters, constructors, and workers of tramways, railways, telegraph, and telephone lines, and electrical works, electricians, mechanical engineers, suppliers of electricity, etc. Private.

DARTMOOR ELECTRIC SUPPLY COMPANY, LTD.—Capital, £4,000, in £1 shares. Objects: To carry on at Bovey Tracey and elsewhere the business of an electric light company in all its branches, and to adopt agreements (1) with J. H. Lee for a lease of a mill and premises at Bovey Tracey, and (2) with A. J. Wyatt relating to the supply of any surplus power required by the company. Minimum cash subscription, £1,500. The first directors (to number not less than four nor more than eight) are: W. Aggett, H. A. Bentinck, J.P., D.L., H. Goodwyn, F.R.C.S., Lucy Hellier, W. G. Hole and P. W. Peters. Qualification, £10. Remuneration as fixed by the company. Registered office, 12, Market-street, Newton Abbott, Devon.

G. W. CLARKE & COMPANY (LIVERPOOL) (LTD)., ELECTRICAL ENGINEERS.—£1,000, in £1 shares (250 Def.).

HOLOPHANE.—£100,000 (£1) (100,000 7% preference). To acquire from O. A. Mygatt, of Paris, all his interests in the Holophane system of illumination in all parts of the world, except France and the French colonies. First directors (to number not less than three nor more than seven): O. A. Mygatt (president of the Holophane Glass Company of New Jersey), Lieut.-Col. F. J. P. Butler, G. C. Glyn, D.S.O. (manager Holophane Company of London), Lord Ernest William Hamilton, and R. Woodhouse) jun. 250 shares. £100 each per annum (chairman £300, and 15% of the surplus profits remaining after providing for a dividend of 7% on the ordinary shares, divisible. 12, Carteret-street, S.W.

LOCH LEVEN ELECTRICITY SUPPLY COMPANY (LTD).—£10,000, in £10 shares.

THOMAS BRITTAN (LTD.) TELEGRAPH INSTRUMENT MANUFACTURERS, ETC.—£500, in £1 shares. 34, Risinghill-street, Pentonville, N.

WITTON JAMES (LTD.), ELECTRICAL DRIVING EQUIPMENT MANUFACTURERS.—£6,000, in £1 shares (2,000 Preference). 71, Queen Victoria-street, E.C.

COMPANY RESULTS.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY.—The directors of the Newcastle-upon-Tyne Electric Supply Company, Ltd., announce an interim dividend of 1½% on the Ordinary shares, payable 29th instant, less income-tax.

* * *

NEW GENERAL TRACTION.—The accounts of the New General Traction Company, Ltd., state that the revenue from the various sub-companies amounted to £19,482. After providing £376 for the realised loss on certain bonds and £1,500 towards depreciation, there is a profit of £500, reducing the debit balance to £25,306.

* * *

HOVE ELECTRIC LIGHTING.—For the period ended June 30 last the directors of the Hove Electric Lighting Company, Ltd., have declared an interim dividend on the Ordinary shares of the company at the rate of 6% per annum, payable on October 15 next. They have also ordered the payment of the full interim dividend on the Preference shares, due on September 1 next at the rate of 5% per annum for the same period.

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TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

ANSWER.

Question No. 1219.—Consider the possibility of lighting train carriages by acetylene gas and compare this system with lighting by electric glow lamps. Make the comparison with special reference to general convenience, safety, simplicity, economy, influence of weather, colour of light and general operation. How does the necessity to heat cars affect the problem? Information as to the costs of various systems together with notes on electric accumulators and on, say, one constant voltage generator (axle driven) would also be appreciated.

Answer to Question No. 1219 (*awarded* 5*s.*)—The possibility of train illumination by acetylene is certainly one that appears to offer advantages over the older occupants of this field and likely to seriously interfere with the use of electricity for this purpose. An unbiased enquiry will convince us, however, that electric lighting has little to fear from this competitor whose commercial development has been obtained so largely by its aid.

The valuable qualities of this gas are:

(1) Its high actinic property—the light is the nearest approach to daylight.

(2) Its high illuminating power.

(3) Simplicity of generating apparatus.

These advantages are patent to anyone who has seen the acetylene flame and their value would render acetylene an ideal illuminant if only its disadvantages could be eliminated. The vital, and in this country, essential quality of any train illuminant is that no danger to the public is possible under ordinary or extraordinary conditions. Here is a point where it is practically impossible for acetylene to comply with existing conditions. Whether acetylene be stored in gas-holders under the train and supplied under pressure as coal gas, or alternatively each separate lamp have its own generative apparatus, the danger to life exists. The first method of storage would be more practical in working conditions, but the responsibility attached to such an arrangement, having regard to the facts that acetylene is more liable to explosion than coal gas and has such a low ignition point that a glowing cigar is sufficiently high a temperature to cause disaster, is alone detrimental to any general adoption of it in this country. Apart from the far-reaching results of the increasing of dangers from collisions, fires, etc., minor disadvantages exist which deserve mention. This gas has greater percolating properties than coal gas, consequently unless the pipe work of the system is good, leaks are sure to occur; with effects more serious than at first is evident. The chief adulteration to this gas is the poisonous Phosphoretted Hydrogen, which easily becomes a solution in water (Sulphurous Acid), a highly corrosive and destructive agent. It is hardly necessary to point out the bad consequences of such vapours in the case of a full compartment on a long journey, at any rate to children; and secondly, the more frequent gilding, painting, etc., of coaches must also be considered.

It may be argued that the application of the cycle lamp principle to each lamp would solve the leakage question, but in this country the exposed water would become frozen in bad weather, while over generation would also be a trouble, and, indeed, the running costs of so many troublesome lamps would be exorbitant, apart from the renewals of burners, which are notoriously unreliable and require constant attention.

In common with all gas systems, the disadvantage of having to burn all the lamps for some hours unnecessarily consequent to tunnels, could not be easily averted. It must not be forgotten that many railway companies have electrified their stock, and the inter-change of trains nowadays, with the consequent necessity in remote districts of obtaining expensive carbide, would be a source of annoyance, as it is impossible to burn coal gas in the ordinary acetylene burners.

I consider that the heating of carriages is most economically carried out by waste steam from the engine, and it is outside the bounds of possibility to obtain anything like the necessary heat from the acetylene apparatus. The great convenience and complete safety of electric lighting of trains are in themselves sufficient reason for the adoption of this method, providing the cost compares at all favourably with other systems.

That this side of the question can be so easily demonstrated, has been a matter of dispute, but the following figures, which are reliable for the conditions stated, appear to indicate favourably towards the electrical system.

(1) *Cost of Ordinary Gas Lighting* (Per 8 compart. coach year).

	£	s.	d.
Interest 4% on Capital	1	18	2
20,900 cubic ft. of gas at 13s. 7d (including maintenance and interest on plant) ..	14	13	10
Total	£16	2	0

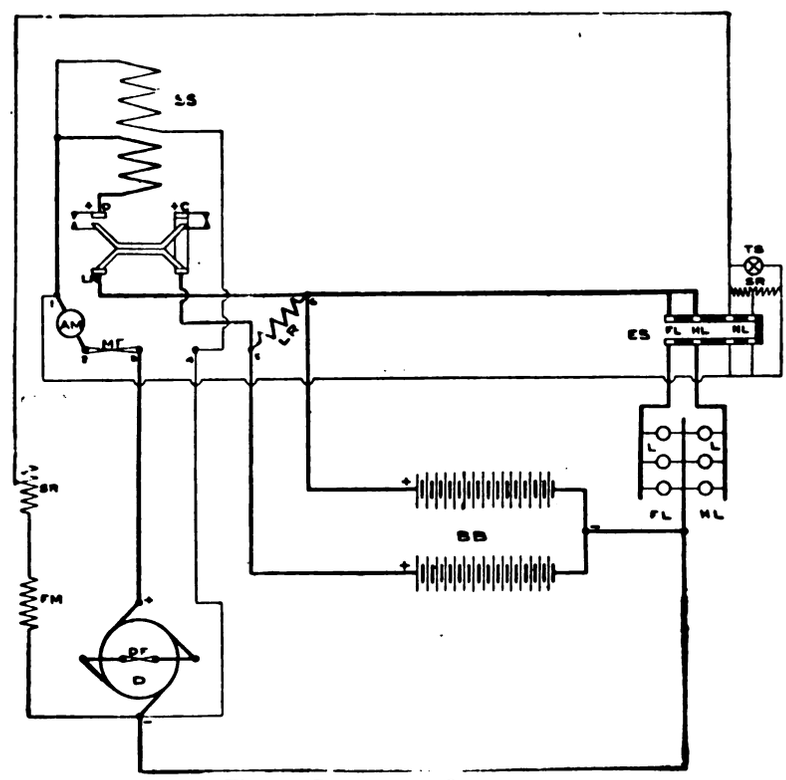

Fig. 1.—Diagram of Connections.

REFERENCES.

A M	Ammeter	F L	Full lights
B B	Batteries	H L	Half lights
+ 0	Positive terminal of cells.	N L	No lights
+ D	Positive terminal of dynamo	L C	Lamp resistance
D	Dynamo	M F	Main Fuse
D F	Dynamo fuse	S R	Shunt regulator
E S	Exterior main switch	S S	Solenoid switch
F M	Field maguet winding	T S	Emergency switch

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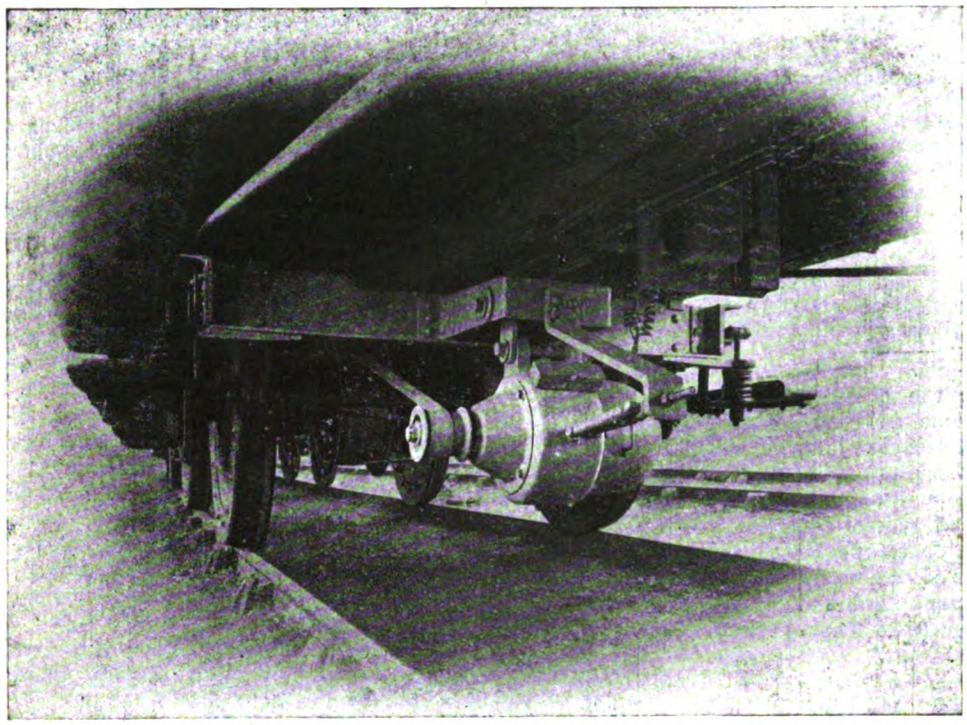

FIG. 2.—DYNAMO FITTED UNDER COACH.

(2) The polarity must not change when rotation is reversed.
(3) A constant voltage must be obtained at the lamps with variable train speed.
(4) This voltage must be very low to ensure safety in operation.

Batteries are necessary to provide light when the dynamo is at rest, and usually each coach is completely fitted out to enable it to be disconnected from a train and still have its own lighting supply. The question of batteries for this purpose has been a subject of careful study by the makers, and the cells as used to-day if kept well up to charge are as reliable as the more mechanical parts of the equipment. The cells are, of course, specially made to withstand vibration, and have lead-lined cases enclosed in teak boxes suspended from the frames.

(2) *Incandescent Lighting* (*Gas*) (Per coach year).

	£	s.	d.
Interest 4% on capital cost	2	16	0
7,000 cubic ft. of gas at 13s. 7d. (as above)..	4	15	1
Mantles (6 per 1,000 cubic ft. of gas)	1	1	0
Total	£8	12	1

(The above figures are abstracted from Henderson's Paper on Train-lighting Proceedings. I.E.E. Vol. 39, July, 1907.)

(3) *Electric Lighting* (*Glow Lamps*) (Per coach year).

	£	s.	d.
Interest at 4% on capital cost.. .. .. (L. & N.W. Ry. Company usual figure.)	3	2	0
Annual cost of maintenance .. .. .. (As averaged from several makers.)	4	10	0
Cost of coal per annum (at 8s. 6d. a ton) .. (Assuming over-all efficiency of 50% from generator to lamps, and 1·5 watts per c.p. with metal filament lamps.)	0	7	9
Haulage cost of extra weight over gas holders	0	5	0
Total	£8	4	9

(4) *Cost of Acetylene* (Per coach year). (Estimate only.)

	£	s.	d.
Interest 4% on capital cost	3	5	0
5,000 cubic ft. of gas at 25s. (as above)	6	5	0
Total	£9	10	0

The above figures may be confirmed by the experience of several large companies, who are, in spite of having had in use incandescent gas lighting (a really practical form of good gas illuminant), converting their stock to electrical systems.

Having then concluded that electric lighting forms the best illuminant, the following is a short description of a typical system as being increasingly employed on Britishrailways.

The essential features of a train lighting dynamo are :—

(1) It must be absolutely weather proof.

The Mather & Platt (*Rosenberg*) *System.* 16/24 volt.—This axle-driven dynamo is of simple construction and operation, and regulates automatically the supply voltage within close limits for the very wide range of speed of the train. It as an over-all efficiency (including belt) of approx. 70% at full load, and quite sparkless operation at all speeds, while its weight is less than that of an ordinary dynamo of same output. Without entering upon the technical explanation of the Rosenberg principle, it consists essentially of a short-circuited pair of brushes between the normal brushes, the field set up by this current producing a cross armature flux which together with the flux produced by the external current re-acts on the main flux, and so prevents the dynamo current rising above a set limit, no matter how high the speed be increased.

Referring to the Diagram of Connections, as the speed increases from rest, the dynamo volts rise very rapidly up to the cell voltage, when the switch SS is attracted, so causing dynamo to feed the battery and lamps in predetermined quantities. At a speed of 18 miles per hour the dynamo gives approx. full output and this is steady up to any higher speed. The effect of reversing rotation alters both the direction of cutting of the cross armature flux, and the direction of the flux in space, so causing the terminals to be still of the same polarity.

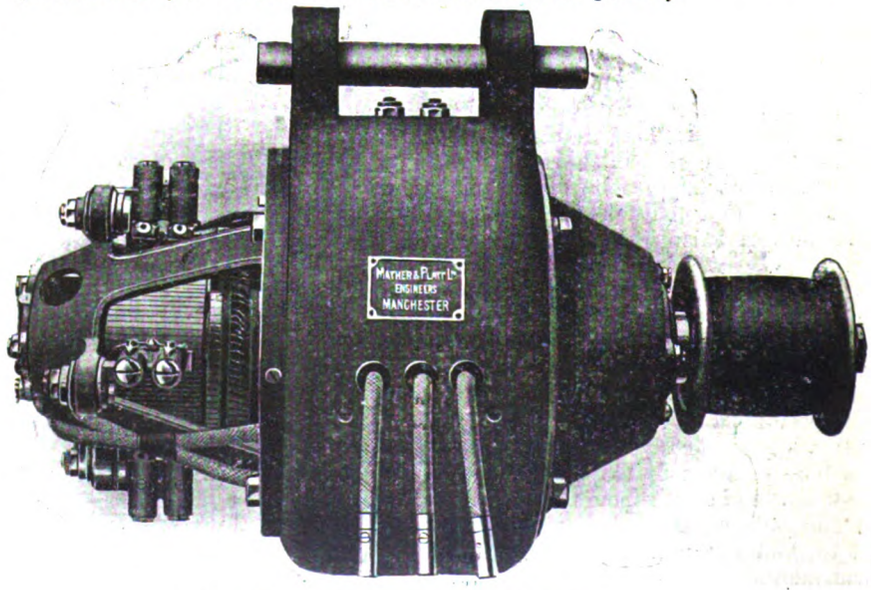

FIG. 3.—FRONT VIEW OF DYNAMO.

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The exterior lamp switches (pull and push type) insert a rheostat into the dynamo field for altering its output to ensure the cells being not excessively charged, while in double battery systems (one battery floating on the lamps) the batteries are interchanged automatically by the lamp switches very frequently to maintain equality of charge. The battery works under very favourable conditions, as it is only charged when lights are in use, so that in winter the extra charge is automatically obtained. A switch is provided, however, in certain cases called an "overcharge" switch which cuts off the dynamo when the batteries owing to special conditions become over charged and conversely causes the dynamo to charge rapidly if batteries fall to too low a value. —"E. P. H."

PATENTS.

Electrical Operation of Gun Mechanism.

12709—1910. H. C. LEAKE, Altrincham, Cheshire. This improved method of actuating and controlling electric motors employed for driving the various mechanisms of turrets on warships consists in the employment of constant current motors, some or all of which are supplied from a single generator. This generator may be driven by a motor connected to the ordinary electrical supply mains on the ship, or in any desired fashion, but in any case it is provided with a winding or regulator by means of which its current output is kept constant in spite of changes in its external circuit.

Electric Switches.

14833.—1909. R. P. HOWGRAVE-GRAHAM, Hampstead. The switch comprises one contact in the form of conducting liquid and a magnetic field which moves the jet with respect to a second contact by its interaction with the electric current passing through the liquid jet.

Automatically Establishing and Cutting-off Electric Supply.

15086.—1909. J. HANSFORD & J. F. WRIGHT, Birmingham. The supply switch is coaxial with a driven timing disc which carries a tappet for opening or closing the supply.

Dynamo Electric Machines.

15319.—1909. R. POHL, Bradford. In this commutating dynamo electric machine, which has salient poles, a compensating winding is provided which extends throughout the interspaces with the magnetic cores arranged outside it at the neutral zone. The compensating conductors are concentrated at the neutral zone.

Motor Control Systems in Rotary Electric Transformers.

15494.—1909. CROMPTON & Co., LTD., J. G. MACFARLANE & H. BURGE, Chelmsford. A motor generator constructed with a single ring armature divided into two portions by a pair of short circuited brushes is employed as a means of speed regulation and regenerative braking. By varying the excitation of one half of the generator, it is enabled to boost the line volts on the driven motor down to zero or up to twice the line voltage.

Electric Carbons.

15647.—1909. R. LESSING, High Holborn. The coal tar, wood tar or other material containing free carbon, and from which part of the volatile matter may have been previously removed, is mixed with a solvent at a suitable temperature. The solution is then separated from the carbon. The undissolved matter, which is in the form of a cake and which contains all the solid carbon of the raw material, is freed from any remaining solvent by steam. The cake is then ground to a powder.

Combined Friction Clutches and Brakes.

16113.—1909. T. MEACOCK, Southend. The working parts of the friction clutches and brakes of the conical face type are arranged within a casing which forms an oil and dust-proof bath.

Electric Shades.

20342.—1909. G. CLARK, Pall Mall, London. In order to prevent the shades of electric lights suspended over billiard tables from swaying when knocked, a horizontal frame is provided which connects each lamp, so that when one lamp is knocked it has the weight of the other lamps to contend against.

Automatic Sequence Switching Device.

20840.—1909. J. E. KINGSBURY, Victoria Embankment, London. This automatic switching mechanism comprises a switch which is electro-mechanically rotated from one switching position to a next intended stopping position, and which in its different switching positions mechanically closes or holds closed, and opens or holds open a series of circuits one after the other or in different combinations, and which in the shifting from one stopping position to another is dependent on the changes to be made in the circuits when the switch is brought to one stopping position having been properly effected.

Trolley Arms for Railless Running Vehicles.

22087.—1909. E. M. MUNRO, Finsbury Pavement, E.C. The object is to provide means whereby the driver can ascertain at any moment how far his vehicle is away from the trolley wire. For this purpose an indicator, consisting of a dial plate and pointer, is provided. The indicator is geared to the trolley arm so that it moves in proportion to the angular movement of the arm. If desired, a bell may be provided for giving an audible signal when the vehicle is near its maximum deviation.

Overhead Tramways.

23504.—1909. E. J. & D. R. FREDERICKS, Princeton, U.S.A. The invention consists in the provision of a specific construction of an entire fitting for the end of the trolley pole and means for enabling the pole to move flexibly at right angles to the direction in which the wheel travels.

Electrical Fittings.

24770.—1909. L. M. WATERHOUSE, Hampton Wick. The object is to construct fuse boxes, ceiling roses, and other electrical fittings in such a way as to render them specially adapted for use in connection with the flexible system of wiring. Ducts are placed in an inner wall of the base of the fitting to form inlets for the conductor. These ducts are extended outwardly as grooves in the face of the base with which the face of the cover makes joint, so that the conductor is gripped between the two faces.

Fuses and Detonators for Blasting.

28532.—1909. H. J. ROBINSON & KYNOCH, LTD., Handsworth. A head of lead is secured to the electric conducting wire by pressure, an enlarged part of the head is secured to the fuse, an extension of the head forms a recess for the flashing mixture which is retained in position by a sealing disc.

Electrolysis of Metallic Solutions.

845.—1910. F. LACROISE, Paris. A cylindrical insoluble anode is used made in one piece and arranged concentrically around the rotating cathode and perforated with numerous small holes, through which the electrolyte passes. The electrolyte which is led into the cathode chamber is given a rotary motion by friction with the rotating cathode, and the liquid is driven outwards through the perforations of the anode. As the flow of the electrolyte is from the cathode to the anode, the ferric salts formed at the anode do not come into contact with the anode, but are removed by the flow of the liquid through the small holes in the anode.

Alternating Current Polyphase Commutator Dynamo Electric Machine.

1611.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. For each brush set hitherto used there is substituted a pair of brush sets spaced and connected with each other through inductive or non-inductive resistances according to the conditions required in such manner as to impart induction motor characteristics to the series commutator machine.

Lamp Shades or Reflector Attachments.

4425.—1910. H. D'OLIER, Philadelphia, U.S.A. A bead member is secured to the incandescent lamp socket which it surrounds and embraces. The bead member is held in position by a resilient ring, which has a bead registering with the bead member. The ring supports the shade or reflector.

Pendants for Electric Lamps.

5735.—1910. A. DOCKING, Nottingham. The pendant has a joint consisting of two pairs of plates at right angles to each other. A ring of balls is inserted between the plates, which ensures a rolling friction and smooth even motion of the pendant.

Railway Semaphore Signals.

10087.—1910. SIEMENS & HALSKE, A.G., Berlin. The locking device is so constructed that the signal is only unlocked by the combined action of a force, acting directly or indirectly on the signal arm in the direction necessary for moving it into danger position.

Machine for Handling Electric Bulbs.

1038—1910. BRITISH THOMSON-HOUSTON CO., LTD., London, E.C. A movable tray is provided which holds the bulbs in parallel rows. A pneumatic lifting device is mounted adjacent to the tray and picks up the bulbs and places them where desired. When one bulb has been lifted and transferred the next bulb is brought into position to be lifted.

Rectifier for High Tension Alternating Currents.

5917—1910. SIEMENS & HALSKE, A.G., Berlin. This high tension rectifier has four fixed contacts, two situated near to each other on one side of the spindle, and two opposite these on the other side of the spindle. Two pairs of conductors are attached to the spindle, which rotates in step with but at half angular velocity of the alternating current, of which one pair parallel to the spindle connects adjacent fixed contacts, and the other pair fixed to the spindle at right angles to the first pair connects opposite fixed contacts. The current source and the device using the rectified current are respectively connected to diagonally situated fixed contacts.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	July 27	1,462	1,528	— 66	— 153	27½	27½	May 31	71,930	17,517,304	1,566,119	·96	11·02	4,949	5·98
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	July 24	1,108	1,062	+ 46	+ 321	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	July 23	6,672	6,255	+ 417	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,273	— 173	— 1,696	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·24	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	July 23	5,484	5,024	+ 460	+ 2,569	98	54·81	„ 31	286,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	July 31	1,391	1,218	+ 173	— 241	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	July 29	6,209	5,801	+ 408	—	57	51½	Dec. 31	265,262	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	July 30	1,287	1,276	+ 11	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	July 24	280	278	+ 2	— 41	6½	6½	„ 22	13,918	2,221,595	430,913	1·04	8·20	1,460	5·85
Cardiff Corporation	April 3	2,090	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	July 23	5,642	5,427	+ 215	+ 1,012	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	July 31	3,128	3,179	— 51	— 65	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 16	200	219	— 39	—	8	—	Mar. 31	10,983	2,306,721	249,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	July 21	553	580	— 27	+ 1,668	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	July 15	1,777	1,454	+ 323	+ 2,885	11½	—	Mar. 31	74,132	16,277,418	1,884,187	1·06	9·56	3,703	7·169
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	July 29	156	146	+ 10	+ 27	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	July 22	5,888	5,937	— 49	+ 573	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	July 23	1,026	1,167	— 141	+ 218	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	July 23	13,537	13,082	+ 455	+ 8,510	195½	189	May 31	907,494	226,948,290	20,796,722	·96	10·49	5,060	5·82
Gloucester Corporation	Oct. 6	895	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·18	1,528	8·49
Huddersfield Corporation	Dec. 4	1,618	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·19
Hull Corporation	July 30	2,746	2,651	+ 94	+ 2,931	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·94
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,285,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	July 27	127	135	— 8	— 114	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	July 27	1,314	1,269	+ 45	— 379	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·04
Liverpool Overhead Railway	July 24	1,432	1,410	+ 22	— 76	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	July 20	41,776	39,776	+ 2,010	+ 93,053	133	118½	Mar. 31	1,274,660	279 166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+ 57	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	July 23	10,738	10,926	— 188	+ 1,311	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	July 31	16,929	16,232	+ 697	+ 1,835	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,710	·85	8·63	1,997	—
Newcastle-on-Tyne Corporation	July 23	4,300	3,804	+ 496	— 58	60½	59½	„ 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·56
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·88	2,693	6·47
Rotherham Corporation	Feb. 4	455	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,000	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	July 24	5,909	5,562	+ 347	+ 5 829	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	July 20	1,138	1,190	+ 51	+ 523	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·242	1,839	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	June 29	142	133	+ 9	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,429	353 297	1·40	1·023	—	—
Wallasey U.D.C.	July 23	1,072	983	+ 89	— 272	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,455	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	July 21	2,503	2,475	+ 28	+ 1,460	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,389	975,714	—	10·929	2,190	6·509

a Train Miles. A Half-year's figures.

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WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Metropolitan Railway Electrification.

The series of Metropolitan Railway meetings, with their tales of increased passenger traffic and growing profits, come well after the interesting discussion of the Mechanical Engineers in Great George-street. The London, Brighton and South Coast carried over two and a half million more passengers on their southern London loop, thanks to the accelerated service and greater comfort of electrification, and so there is to be an extension of the electrical equipment from Peckham Rye, through Tulse-hill, to the Crystal Palace, and from Battersea-park, through Clapham Junction, Balham and Streatham-hill to West Norwood. The arrangement of receiving current in bulk from the London Electric Supply Corporation is to remain in force, though with some modification in favour of the railway.

Other Railways.

The Central London Railway with an increased revenue of £4,597, and a saving of £1,974 is able to pay 3% on the original stock and 4% on the preferred, and to carry forward some £40,000. The extension to Liverpool-street is to be carried forward with all energy, and partly for this purpose £480,000 new capital, carrying a preferred dividend of 4½%, is to be created. The Metropolitan District is steadily improving, showing an increased revenue of £26,727. The three tube railways, the Baker-street and Waterloo, the Charing Cross, Euston and Hampstead, and the Great Northern, Piccadilly and Brompton, which have now been amalgamated under the title of the London Electric Railways, have all done well. In the first named case the gross revenue amounted to £93,891, an increase of £2,380, while there was a saving in working expenses of £145. In the second case the revenue was £105,626 (increase of £444), with a decrease of £2,256 in working expenses. In the last named the revenue was £166,106 (increase of £8,113), with a decrease of £3,802 in working expenses. On the other hand we find non-electrified lines, coming in competition with tubes or electric tramways, having to deplore continued losses.

Depreciation on Electric Machinery.

In a recent issue we discussed that important phase of the administration of electricity undertakings: the policy to be pursued in writing off in the books and balance sheets depreciation on plant and appliances. We then reviewed a scientific system elaborated by Mr. Leake. It is interesting to find one of our most enterprising of municipal electricity undertakings, namely, that of the Corporation of Glasgow, adopting a definite policy. The rates put forward by the Glasgow Committee for depreciation on the various items in the capital account for the year 1909-10, are as follows: Lands and buildings, 1%; machinery, plant, instruments, transformers, etc., 3½%; accumulators, 5%; mains and cables, 2%; and meters and indicators, 4%. On the basis of the rates for 1908-9 the depreciation for the year 1909-10 would be £57,930 18s. 4d. On the basis now proposed by the committee the amount will be £43,474 18s. 1d., or a difference of £14,456 0s. 3d.

German Electric Amalgamation.

A further step in the pooling of interests of the big electrical engineering firms in Germany is about to take place. On the 23rd of this month the shareholders of the Guilleaume-Lahmeyer Company are to meet and consider a proposal for an exchange of shares with the Zurich Electro Bank. The bank will give fifteen million, seven hundred and fifty thousand of its franc shares for the 25 million of mark shares of the Guilleaume-Lahmeyer Company. The Zurich Electro Bank is, of course, the amalgamating media which is under the control of the Berlin General Electric Company, which has already some form of working arrangement with the Siemens-Schucker group. This undoubtedly means a formidable fighting organisation.

Russian Outlook.

Russia, though hitherto backward in the matter of adopting electricity, is determined to alter matters. Evidence of this is to be seen in various municipal schemes, in the (postponed) Railway Exhibition, and now by the despatch of State Councillor Chatelaine, of the St. Petersburg Polytechnic Institute, to America, where he is to investigate on behalf of the Minister of Trade and Industry the whole system of hyrdo-electrics. The aim is to develop the immense water power within the empire for the generation of electricity. Should this intention be carried out even on a small scale by the Imperial Government it would give a tremendous impetus to industry, for municipalities and financiers would seek concessions. Russia, therefore, will probably be buying in the near future not only many hydraulic equipments, but also a vast deal of electrical machinery, and orders will assuredly go to those who go in search of them.

Queer Proceedings.

A Central Station electrical engineer of high standing writes to us to the following effect: "Electrical engineers whose Councils are considering the lighting of their streets by metallic filament lamps, or who at present are using this means of lighting, are warned that recently a gas company in London was found to temporarily remove the lamps from columns during lighting hours, their object in doing so being stated to be 'for testing.' Viewing the fragile character of the metallic filament lamps it cannot be stated to be just competition to tamper with such apparatus; moreover, the fact that all tests as to efficiency of lighting can be carried out without interfering with the source of light, whether it is gas or electric, renders such an action unjustifiable. Although one cannot but admire the persistence with which the gas companies are waging a hopeless warfare in endeavouring to recapture street lighting, I think they have overstepped the bounds of commercial morality, and have at the same time committed a breach of the law." The proceedings are certainly so extraordinary that it is well to give the utmost publicity to them.

CATALOGUES AND PRICE LISTS.

James McMillan & Company: Illustrated leaflet on "Standard" autogenous welding apparatus.

The Reflector Syndicate Ltd.: Illustrated description of the Cowper-Coles' electro-deposited gold and other reflecting mirrors for search and head-lights.

Cowper-Coles' Galvanising Syndicate, Ltd.: Illustrated description of regenerative galvanising process.

General Electric Company, Ltd.: Leaflet S.1411, giving prices and particulars of Coats' Patent Insulating Shields and Wall Plugs in Cast-Iron Cases, designed to meet the requirements of the new Home Office Rules.

S. H. Heywood & Company, Ltd.: "Transva" Parcel Conveyer, designed and patented by Mr. T. R. Wollaston, M.I.M.E.

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COST OF ELECTRICALLY-PROPELLED SUBURBAN TRAINS.*

By H. M. Hobart, M.Inst.C.E., M.I.E.E.

PRELIMINARY CONSIDERATIONS.

The commercial aspects of applying electricity to the propulsion of suburban trains involve many factors and the thorough investigation of any one of these factors requires careful study. In the present Paper the author's aim is to focus attention chiefly on the rolling stock, but it must not be inferred that he implies that the other factors affecting the total cost are of minor importance. It is absolutely insufficient to approach the subject of railway electrification from the standpoint that it resolves itself into a mere question of contrasting electric propulsion with steam-locomotive propulsion. Were it not for conditions relating to the large amount of capital already invested in steam railways, it is certain that the merits of electrical methods, would, so far as concerns suburban passenger traffic, lead to their general adoption. But the great cities of the world are already very liberally supplied with steam railways which, in addition to much other important traffic, at present handle the suburban passenger traffic for which electrical methods have, on many occasions, been demonstrated to be especially appropriate.

Let us, however, conjure up the hypothetical case that London is served by all but one of the older of the several great railways now entering it (and which are all of proven necessity), and that the project is mooted of adding this one urgently-needed railway. Under these circumstances the author doubts if there would now be found more than a small minority of railway engineers who, in the face of the demonstrated successes of electrical methods of propulsion, would advocate that the suburban passenger service of this new railway should be handled by steam-locomotives. The new terminus would probably be designed and equipped so that the suburban traffic would consist exclusively of electrically-propelled trains. It is equally probable that beyond some 25 to 30 miles from London the through trains would be drawn by steam-locomotives. The through-goods traffic would also be operated by steam-locomotives. As to whether the long-distance trains should leave the terminus behind steam or electric locomotives is less apparent, and is, futhermore, a matter of secondary importance, since the presence of a certain number of non-stopping steam-trains is entirely consistent with the maintenance of an effective service of electrically-propelled suburban passenger-trains. Consequently it would not require any drastic alteration of methods gradually to tend more toward steam or more toward electricity for propelling the through trains when traversing the tracks within the 30-mile radius. This hypothetical case has simply been cited in order to emphasise more forcibly, the generally-admitted fact that it is no longer a question of whether in electricity, there has arrived a better agent than the steam-locomotive for the handling of suburban traffic. On the contrary, the exclusive (though often amply sufficient) reason for delay in replacing steam-locomotive methods by electric propulsion, is, so far as concerns the suburban passenger traffic, nearly always related to the large capital expenditure involved in effecting the change. For not applying electrical methods to other classes of railway traffic there is, so far as relates to Great Britain, the best of all reasons, namely that steam is, at present, in almost all instances, more economical.† In countries where coal is scarce and water-power abundant, as, for instance, in Sweden, Italy, and Switzerland, the general electrification of the railways may be a thoroughly sound proposition, but the distinction between the conditions in Britain and in the countries cited is obvious.

In view of the circumstances, the question of the relative cost of various electrical systems of operating suburban lines becomes one of great importance. Although it would be premature to deny the claims of certain further systems of electrical propulsion, the two systems which are, at the present time, chiefly commanding attention, are the systems employing on the trains continuous-electricity motors and single-phase motors respectively. With a view to concentration, only these two systems will be taken into account.

The conventional methods which are employed in analysing the expenses of operating steam-railways involve, when applied to estimates for the electrical operation of railways, a considerable degree of obscurity and lead to misunderstandings. The obscurity is often intensified by any attempt to adapt these methods, by slight modifications, to the new conditions attending electrical operation. For the particular investigation which constitutes the object of this Paper, it will conduce to clearness to break away completely from these conventional methods of analysing costs. This is the more justified since the Paper deals with broad comparisons, leading to broad generalisations. Were it a question of final and detailed estimates the method employed in this Paper would obviously be inappropriate.

A railway is an undertaking of such magnitude that, with the extensive adoption of electricity for propulsion, it would often be in the interests of economy for the railway to provide and operate its own electricity-supply stations, and thus save the profits which would be included in the prices at which electricity-supply companies would be prepared to sell the electricity. Nevertheless it is electricity-supply companies, and not the railways, which are at present in a position to supply a railway's requirements to best advantage, and in view of the circumstance that any single railway almost always traverses districts served by many different electricity-supply companies, it is highly probable that for some long time to come, at any rate, a railway would, in many cases, be serving best its own interests by purchasing its electricity from electricity-supply companies and municipal electricity-supply undertakings. It is by no means necessary for the author to investigate this question further, but merely to state that in this investigation, he will assume that the railway not only purchases its electricity from independent undertakings, but that it looks to these independent undertakings to provide all transmission lines from the points where the electricity is "generated," and also to provide all the sub-stations, thus delivering the electricity at the required points on the railway company's premises in the form in which it is collected by the trolley-bows or rail-shoes carried by the train. The sub-stations are thus the property of the electricity-supply company. The railway is, however, the proprietor of all the cables and structures intermediary between the sub-stations and the trains.* These structures may consist in an overhead trolley-system, or in conductor-rails, together with (in either case) the necessary feeders. When the single-phase system is employed, the sub-stations may contain stationary transformers or they may consist simply of buildings provided with high-pressure switch-gear for controlling the inter-connections of the various sections of the line. When the trains are equipped with motors operated by continuous electricity, the sub-stations will be more numerous, and they will be provided chiefly for the purpose of housing motor-generator sets transforming the high-pressure polyphase electricity received from the electricity-supply station, into the relatively low-pressure continuous-electricity required at the train. The price charged by the independent electricity-supply undertakings will be for the electricity in the form in which it is delivered from the sub-stations, and owing to the greater cost and lower efficiency of the sub-stations when supplying continuous-electricity, the railway will be obliged to pay a higher price for a given quantity of electricity when it is in the continuous form than when it is in the single-phase form. Prices arrived at by experience on a large scale are now quite well agreed upon for electricity in these two forms. While these prices vary greatly according to the price of fuel and various factors of like nature, and while they also vary greatly with the nature of the load, they can nevertheless be estimated with certainty in any particular case.†

Thus, so far as the outlay for electrical apparatus and equipment is concerned, this method of comparison leads us to the definite proposition of estimating the cost of the rolling stock and the cost of the structures along the line, intermediary between the sub-stations and the trains. While the cost of these structures has, up to the present, been higher with the single-phase than with the continuous system, the author does not propose in this Paper to discuss these differences, but he will, on the contrary, assume that the outlay for this portion of the work is the same for both systems. As to the cost of the trains, estimates for each system will be made, since in this respect the two systems differ greatly from one another.

To fix ideas, the author will confine his comparisons chiefly to trains consisting of three double-bogie coaches. It is well known that, under reasonably favourable conditions, such trains usually yield gross receipts of some 40d. to 60d. per train-mile. The cost of the electricity required for the propulsion of the trains, together with reasonable estimates for the capital charges for the trains, including the outlay for their depreciation, repairs and renewals, make up an aggregate per train-mile which is usually of the order of from 35 to 40% of the amount of the gross receipts. Into the disposition of the remainder of the gross

* Paper read at the Joint Summer Meeting of the Institution of Mechanical Engineers and the American Society of Mechanical Engineers.

† This is usually the case. The presence of frequent tunnels may afford the chief reason for adopting electricity on a given section, owing to the elimination of smoke and steam. But if it is proposed to employ a bare 6,000 volt overhead conductor for supplying the trains, the presence of tunnels of small dimensions may afford the most cogent reason for adhering to the steam-locomotive. Heavy grades are much more readily negotiated by electrically-propelled trains, and consequently, for mountain lines, there is an additional incentive for substituting electrical propulsion for steam-locomotive methods.

* The railway, in that it owns the property on which its tracks are laid, possesses a great advantage over electricity-supply companies since it can construct its transmission line (whether overhead or underground) without conforming to so many (sometimes obstructive) regulations, and without payment for way-leaves. By co-operation in extending these advantages to the electricity-supply companies from whom it purchases the electricity, an appreciably lower price should be obtained.

† By allocating to the electricity-supply company the burden of providing the transmission system up to the sub-stations, and also the sub-stations, legitimate simplifications are introduced into the calculations, since there are in Great Britain many electricity-supply companies who are prepared to promptly quote prices for electricity as delivered at the outgoing cables from such sub-stations. For given conditions as regards load-factor and price of coal and water, the market price of electricity has for some time been quite a definite quantity.

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receipts it is not proposed to enter, since (taking the electrical structures along the line,* that is, the equipment intermediary between the sub-stations and the trains, as representing the same outlay, irrespective of the particular system of electric traction adopted), the disposition of this remainder will be substantially the same, whichever system is employed, and hence does not materially affect the results in a comparison of systems. It is to the application of that portion of the gross receipts (roughly 35 to 40% or thereabouts), the precise amount of which is seriously affected by the selection of the service and of the system of electrification, that the author will direct his investigations. It may be said that he is guilty of comparing alternative systems of electrical operation to the disadvantage of the interests of electrical operation in general, but he does not admit this to be the case. On the contrary, a correct interpretation of his results will show that his object is to consecrate each system to its appropriate purpose, and to admit fully that for long-distance through trains, steam-locomotive methods are superior to any electrical methods as at present developed. For high speeds with frequent stops, while both the single-phase system and the continuous system have long been recognised to be adequate as regards their engineering features, the former entails, as he will endeavour to show in this Paper, distinctly greater outlay and distinctly less net earnings. He will also endeavour to show that with decreasing speed for a given distance between stops, or with increasing distance between stops for a given speed, the disabilities of the single-phase system become less acute. The determination of the point beyond which the use of the single-phase system will conduce to greater net earnings than can be obtained by the system employing continuous electricity at the trains, is, however, not within the range comprised by the subject assigned to the Joint Meeting for discussion, namely "The Electrification of Suburban Railways," and hence cannot appropriately be dealt with in this Paper. Quite aside from any question of the relative merits of alternative systems, the author would be pleased if the results which he has deduced as regards the cost of the rolling stock and of the electricity consumed in its propulsion, should be found useful in dealing with electric-railway investigations.

The severity of a train service is a function of the schedule speed and of the distance between stops. For a very severe service, many of the train-axles are often driven by motors, while for more moderate services it suffices to concentrate the driving power upon but a few of the axles. In eliminating the locomotive and placing the motors under the passenger-coaches, the space available for the motors is rather restricted, and the plan of distributing several relatively small motors on several axles is more often a consequence of this space-limitation than of any regard for obtaining greater tractive effort by the greater total weight on the driven axles. Although this latter object is always kept in view, it may be said that even the high accelerations employed on electric railways rarely require so great a subdivision of the driving power as is, for severe services, usually resorted to, owing to the space-limitations.

Analysis of two 150-foot Trains.

The author proposes first to analyse the design and performance of two 150-ft. trains designed for about the same "average output," and similar as regards the capacity and distribution of the electrical equipment. In the two 150-ft. trains which have been selected for this analysis, only two motors are employed, and these drive two of the four axles of a motor-coach. Each of these 150-ft. trains comprises three 50-ft.† coaches, of which one is a motor-coach and the other two are trailer-coaches. Thus out of the twelve axles, only two are driven. The first of these two trains is a type designated A, which is employed on the Piccadilly-Tube Railway in London and weighs 61 tons; the second is a type designated C, which is employed on the Heysham, Morecambe and Lancaster Branch of the Midland Railway and weighs 77 tons. The service for which the 61-ton Piccadilly-Tube train is employed requires a schedule speed of 16·4 miles per hour, and the runs are of an average distance of 0·45 mile between stations. The 77-ton Heysham train has a schedule speed of some 31 miles per hour, and there is an average distance of 4 miles between stations. It might appear at first sight that these two services are not comparable, but brief calculations are given below, showing that the average output to the axles is just about the same in the two cases. Furthermore, the average efficiencies of the two electrical equipments do not differ by more than 5% at the outside. This is also the case as regards the efficiency in the two cases of 180-ft. trains, examined in a later section of this Paper, and with a view to avoiding a discussion of so unessential a matter as a few per cent. difference in efficiencies, the author has, throughout his comparisons, employed the mean value of 70%. His examinations indicate that in no one of the four cases (that is, the two 150-ft. trains and the two 180-ft. trains) is the average efficiency of the electrical equipment on the train for the services for which the trains are employed greater than 72% or less than 68%; consequently the employment throughout of the value of 70% is amply exact and is in the interests of simplicity. The two particular instances of two-motor, 150-ft. trains have been taken because precise data of their design and performance is available, and because, while they are equipped for about the same average output, the one train carries continuous-electricity equipment and the other carries single-phase equipment. For the 61-ton Piccadilly train, the output of the equipment, averaged over the entire time, including stops, is 87 h.p.; for the 77-ton Heysham train the corresponding figure is 90 h.p. The total weight of the electrical equipment in the two cases is 8·0 tons* and 14·9 tons respectively. In each case the service is that for which the equipment was selected,† and in each case the ultimate temperature-rise in regular service is of moderate amount.‡ Thus we have:—Average output in service per ton of electrical equipment—

$$\frac{87}{8{\cdot}0} = 10{\cdot}9 \text{ h.p. for the Piccadilly train,}$$

and

$$\frac{90}{14{\cdot}9} = 6{\cdot}04 \text{ h.p. for the Heysham train.}$$

The calculations are set forth in parallel columns in Table 1.§

Analysis of two 180-foot Trains.

Having now examined two 150-ft. trains composed of one motor-coach and two trailers, let us turn our attention to two trains for more severe services. The two trains which the author has selected for his purpose are each 180 ft. in length and are each composed of two motor-coaches and one trailer-coach. Each coach is 60 ft. in length. Each motor-coach is equipped with four motors, making up a total of eight motors per train. Thus eight of the twelve axles of the train are driven by motors, whereas in the two former trains only two out of the twelve axles were driven. The first of these two 180-ft. trains is of a type which may be designated as B, and which is employed on the Southport line, and the second which may be designated as D, and which is one of the trains now operating on the South London Elevated Railway. The trains are thus somewhat longer and are much heavier than those which we have examined before. The weights of these two 180-ft. trains are respectively 118 tons and 138 tons. The Southport train runs at a schedule speed of 30 miles per hour, and the average distance between stations is 1·32 mile. The South London Elevated train, (S.L.E. train), runs at a schedule speed of 22 miles per hour, and the average distance between stations is 0·88 mile. The striking similarity of these trains as regards their length (180 ft.), their seating capacity, and the proportion of motor and trailer-coaches, has led to the establishment of comparisons between them. But these comparisons have usually been of an utterly superficial nature. It has been said that since in the case of the Southport train the stops are less frequent and the speed is higher, the severity of the service is substantially the same as in the case of the S.L.E. train, and it has been assumed, though altogether incorrectly, that the more frequent stops in the case of the S.L.E. train offset the greater speed in the case of the Southport train. The author has, however, pointed out on various occasions that this is not the case. On the contrary, the power which is required at the axles in the case of the Southport 118-ton train is 42% greater than the power which is required at the axles for the S.L.E. 138-ton train, notwithstanding the 18%

* This is the only electrical item which is not included in the comparisons, and since it will introduce no serious error to take this item as independent of the particular electrical system adopted, the author considers it preferable, in this investigation, to group it with the various non-electrical items (including net profits) which make up the remaining 60 to 65% of the gross receipts, and which, directly, are independent of the precise electrical system adopted, although indirectly they may be appreciably affected. For instance, the design and weight of the train affects the permanent-way outlays.

† Throughout this Paper, it has been convenient to take as the length of the train the length of each coach multiplied by the number of coaches, that is, the length corresponding to buffers and couplings has not been included.

* This estimate of 8·0 tons is somewhat in excess of the weight usually assigned to the equipment of the Piccadilly-Tube trains. The figure usually given is 7·3 tons, but the author prefers to take 8·0 tons since the weight of auxiliary equipment tends to gradually increase in successive installations. This is because with the development of electrical methods, refinements are introduced which were not deemed necessary in the earlier work. This estimate of 8·0 tons is ample to cover air-compressors and governor, all cables, slate switch-panels, collecting shoes, and shoe-beams for both trucks of the motor-coach, steel-tubing, bolts, cleats, etc. The estimate of 14·9 tons is for the Siemen's Company's equipment as installed on the Heysham train.

† In both cases, the capacity of the motors is probably sufficiently liberal to permit that the motor-coach, with its equipment, may haul three trailers instead of two, for considerable periods. Indeed, four-coach Piccadilly trains have been found by tests to be well within the capacity of the two motors of a single motor-coach. But, nevertheless, the use of two trailers per motor-coach is, both for the Piccadilly and the Heysham lines the normal case.

‡ Whereas, in the case of the Piccadilly-Tube train, forced draught is not employed, the motors on the Heysham train are only maintained at a sufficiently low temperature by employing forced draught. Consequently the lightness of the continuous-electricity equipment, as compared with the single-phase equipment of the same average output, is the more marked. It should be further borne in mind that, in endeavouring to keep down their weight, single-phase motors are designed with a higher speed, in revolutions per minute, than has been considered good practice with continuous motors, and the required speed at the train-axles is in single-phase trains obtained by the interposition of undesirably high gear ratios.

§ In these calculations, as also in those in Table 2, the values for the energy consumption per ton mile correspond with the representative values given in Table 7, and represent the consumptions under the conditions of test runs. The question of the additional consumption to allow for the conditions of routine service, is introduced in a later section of this Paper.

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TABLE 1.

	Piccadilly Train.	Heysham* Train.
Number of motor-coaches	1	
Number of trailer-coaches	2	
Total number of coaches in the train ..	3	
Number of motors	2	
Total number of axles in the train ..	12	
Number of axles driven by motors ..	2	
Length of train .. .. .. feet	150	
Weight of train .. .. .. tons	61	77
Schedule speed (a) .. miles per hour	16·4	31·0
Distance between stops .. .. miles	0·45	4
Energy consumption per ton-mile w.hour	93	40
Energy per train-mile (b) .. kw. hr.	5·67	3·08
Average input per train ($=a \times b$) .. kw.	93·0	95·6
Average output from motors to axles (taking average efficiency of electrical equipment as 70%) .. .. .. h.p.	87	90
Weight of electrical equipment .. tons	8·0	14·9
Average output per ton of electrical equipment .. .. h.p.	10·9	6·04
Ratio of these two average outputs per ton of electrical equipment	$\frac{10·9}{6·04} = 1·81$	

greater weight of the latter train, and the power required at the axles, per ton of total train weight, is no less than 65% greater for the Southport service than for the S.L.E. service. Some engineers are doubtless well aware of the erroneous character of the assertions which have been made in this matter, but it is probable that other engineers have unguardedly accepted the assertions, and have concluded that for practical purposes the two services may be regarded as substantially equal in severity.

The service performed by the Southport 118-ton train requires of the electrical equipment an output to the axles, averaged over the entire run, of 319 h.p., whereas the relatively much-less-severe service of the S.L.E. 138-ton train requires an output to the axles of only 225 h.p. The weights of the electrical equipments in the two cases are, however, 30 and 44 tons respectively. The average horse-power output to the axles per ton of electrical equipment, works out respectively at 10·6 h.p. for the Southport train,† and 5·12 h.p. for the S.L.E. train. In

TABLE 2.

	Southport Train.	South London Elevated Train.
Number of motor-coaches	2	
,, ,, trailer-coaches	1	
Total number of coaches in the train ..	3	
Number of motors	8	
Total number of axles in the train ..	12	
Number of axles driven by motors ..	8	
Length of train .. .. .. feet	180	
Weight of train .. .. .. tons	118	138
Schedule speed (a) .. miles per hour	30	22
Distance between stops .. .. miles	1·32	0·88
Energy consumption per ton-mile w.-hr.	96	79
Do. per train-mile (b) .. kw.-hr.	11·3	10·9
Average input per train ($=a \times b$) .. k.w.	340	240
Average output from motors to axles (taking average efficiency of electrical equipment at 70%) .. .. .. h.p.	319	225
Weight of electrical equipment .. tons	30	44
Average output per ton of electrical equipment .. .. h.p.	10·6	5·12
Ratio of these two average outputs per ton of electrical equipment	$\frac{10·6}{5·12} = 2·07$	

* The electrically-equipped rolling stock on the Heysham line comprises three such trains. Their aggregate mileage for the year ending June 30, 1909, was only 86,000 miles, or an average of only 79 miles per train per day. At 31 miles per hour this works out at only 2½ hours per train per day. In the analysis, however, the author is crediting the Heysham trains with having an equipment adequate to work to a schedule speed of 31 miles per hour for many consecutive hours. The Piccadilly-Tube trains do this, day after day, a single train often maintaining its schedule speed for 18 consecutive hours and covering in that time 300 miles.

† As a matter of fact, the Southport trains operating to the schedule in question, while still comprising two motor-coaches (each equipped with four motors) very frequently have two trailer-coaches, and it is consequently very conservative to take the three-coach train as representative of the capacity of the electrical equipment of two motor-coaches. In the Board of Trade returns for 1908, the electrical train service on the Southport line is given as 1,490,000 train miles and 5,120,000 car miles. The average train thus comprises 3·4 coaches, which more than justifies the author's standpoint. Possibly also the S.L.E. equipment has a similar margin of capacity. Whether or no this be the case, it is as well to base the comparisons on the three-coach trains in each case, although this is decidedly less than the normal train for the Southport line whereas it is the standard type of train operated on the S.L.E. Railway.

Table 2, these calculations are set forth in parallel columns. The calculations in Table 2 correspond to the conditions indicated in footnote.

It will be observed that the average output per ton of electrical equipment varies greatly in the four cases which we have examined, and questions naturally arise as to the cause of these great variations. It might be suggested that the variations are attributable to diverging views as to correct methods of design. As it happens, however, the equipments were supplied by four different manufacturers who are amongst the half-dozen firms who probably have the greatest experience in the manufacture of electric railway equipments. Denoting the four examples as A, B, C and D, we arrive at Table 3.

Engineers familiar with the relative standing of the leading manufacturers of electric railway apparatus, are well aware that each of these four firms has resources of such magnitude that they are all on a substantially equal footing as regards ability to produce the best, lightest and cheapest apparatus for the purpose in view. Consequently we must seek some other explanation for the striking difference in the results set forth in Table 3. The two first results are within 3% of each other and

TABLE 3.

Example.	Average output per ton of electrical equipment.	Railway.	Manufacturer.
	h.p.		
A	10·9	Piccadilly ..	B. T. H. Co.
B	10·6	Southport ..	Dick, Kerr & Co.
C	6·04	Heysham ..	Siemens.
D	5·12*	S.L.E. ..	A. E. G.

the two last results are within 18%† of each other. The mean of the first two results is 10·8 h.p. per ton, and the mean of the last two results is 5·6 h.p. per ton. These two values have the ratio 1·93 : 1·00. The reason for this difference in weight of about 2 to 1 is that in the first two cases (that is, the Piccadilly-Tube 61-ton train and the Southport 118-ton train) the equipments are designed for, and operated with, continuous electricity, whereas the last two cases (the Heysham 77-ton train and the S.L.E. 138-ton train) have equipments designed for, and operated with, single-phase electricity.

As rough, but representative values, we may take it that for a train equipped with continuous apparatus, the electrical equipment may, in actual service, and for approved overload and heating limits, be loaded up to an average output of 11 h.p. per ton weight of the equipment, whereas single-phase equipments can only be worked up to an average output of 6 h.p.‡ per ton. It has been asserted that notwithstanding that the single-phase equipment for a train required to perform a given service, weighs twice as much per h.p. as the corresponding continuous equipment, this does not seriously affect the total train weight, since the weight of the electrical equipment constitutes (it is alleged) only a small part of the total weight of the train. Let us investigate this assertion. In Table 3 the

TABLE 4.

System.	Designation of train.	Railway.	Length of train.	Total train-weight.	Weight of electrical equipment.	Percentage which weight of electrical equipment constitutes of the total weight of the train.
			feet.	tons.	tons.	per cent.
Continuous	A	Piccadilly	150	61	8·0	13·1
,,	B	Southport	180	118	30	25·4
Single-Phase	C	Heysham	150	77	14·9	19·3
,,	D	S.L.E.	180	138	44	32·0

four trains have been designated as A, B, C and D. In Table 4 are given the total train-weights, the weight of the electrical equipment, and the percentage which the weight of the electrical equipment constitutes of the total train-weight.

* That the S.L.E. equipment works out at only 5·12 h.p. per ton while the Heysham equipment comes to 6·04 h.p. per ton, is satisfactorily explained by the circumstance to which allusion has already been made in the footnote below Table 1, to the effect that the Heysham train only averages (over the whole year) some 2½ hours of service per day whereas the S.L.E. trains will doubtless average (over the 365 days in the year) at least twice this number of hours of service per day. It is stated that for the S.L.E. line, "the mileage of each train in service varies between 250 and 500 miles per day."

† The reason for this 18% difference is given in the footnote to Table 3.

‡ It should be noted that the author is favouring the single-phase system very decidedly in crediting it with an average output of 6 h.p. per ton, for this value is only attained in the case of the Heysham trains, which only average 2½ hours in service per day, whereas the S.L.E. trains, which do an average of, say, 5 hours per day, yield an average output per day of only 5·12 h.p. per ton-weight of electrical equipment.

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TABLE 5.

System	Continuous.		Single-Phase.	
Designation of Train	A	B	C	D
Road	Piccadilly	Southport	Heysham	S.L.E.
Length of train ft.	150	180	150	180
Weight of train tons	61	118	77	138
Average output during service h.p.	87	319	90	225
Do. per ton weight of train .. h.p.	1·42	2·70	1·17	1·63

Comparing the 180-ft. trains, that is, trains B and D, we have seen that the Southport service is much the more severe, yet the electrical equipment of the Southport train only amounts to 25·4% of the total weight, as against 32% of the total weight for the much-less-severe S.L.E. service. It should be of interest to ascertain how a train of the "D" type would require to be modified in order to be suitable to perform the "B" service. This and subsequent calculations will be simplified by first working out, for all the trains, the average h.p. per ton weight of train required for the respective services. This is done in Table 5.

The values in the lowest horizontal line of Table 5 are the real criteria of the severity of the service, and we see that the Southport service requires $\left(\text{since } \frac{2{\cdot}70}{1{\cdot}63} = 1{\cdot}65\right)$ 65% more average power per ton weight of train than is required for the S.L.E. service. The values in the lower line of Table 5 are (since the efficiency is the same) independent of whether single-phase or continuous apparatus is employed. For the Southport service, there must be provided 2·7 h.p. per ton weight of train. Since we have seen that, with single-phase equipment, we obtain 6 h.p. per ton of equipment, we shall require $\frac{2{\cdot}7}{6{\cdot}0} = 0{\cdot}45$ ton of electrical equipment for every ton of total weight of train. Thus 45% of the weight of the train will consist of electrical equipment.

The motor-coaches on the S.L.E. line weigh 54 tons each. Of this 54 tons weight of one of these motor-coaches, only 22 tons, that is, only 41% of the total weight of the motor-coach is electrical equipment, and consequently the motor-coach which is at present running the S.L.E. service, even with its motors rewound for the required speed, would not have sufficient capacity (leaving the same margin as on the present S.L.E. service) to accomplish the Southport schedule with the same heating of the electrical equipment as in the S.L.E. service, much less could a train composed of two motor-coaches and one trailer accomplish this schedule with normal heating and with appropriate overload capacity. In order to work the S.L.E. 180-ft. train to the Southport schedule, its electrical equipment must be considerably increased in weight. Let W equal the total weight of the S.L.E. 180-ft. train, in tons, when reinforced to render it adequate for the Southport service. Then the electrical equipment must weigh 0·45 W. The weight of the S.L.E. 180-ft. train, exclusive of the electrical equipment, is 138—44 = 94 tons. Its revised weight when provided with an equipment enabling it to conform to the Southport service, will consequently be $W = 0{\cdot}45 \times W + 94$. Consequently we have:—W = 171 tons.

The weight of the electrical equipment must thus be:—

$$171 - 94 = 77 \text{ tons,}$$

and the electrical equipment will be capable of delivering an average output of 6 × 77 = 462 h.p. Thus the equipment of the S.L.E. train must be increased, as regards its average output, from the 225 h.p. which sufficed for the S.L.E. service, up to the 462 h.p. necessary in order that it may accomplish the Southport service. This is an increase of 105%. The revised S.L.E. train requires to have 462 h.p. average capacity as against the Southport train's 319 h.p. average capacity, an excess of 45%. This further 45% serves no more useful purpose than to carry over the route the increased weight of expensive electrical equipment made necessary by the use of the single-phase system. The revised S.L.E. train weighs 171 tons, as against the Southport train's weight of only 118 tons. Thus the result is, that while both trains have the same length of 180 ft., the S.L.E. train, when altered to be adequate to perform the Southport service, weighs 45% more than the Southport train. Moreover, the revised three-coach single-phase train for the Southport service would have to consist of three motor-coaches, in place of the two motor-coaches and one trailer which sufficed to carry the necessary single-phase equipment to perform the S.L.E. service.

Let us next reverse the above process and adapt the Southport train to the S.L.E. service of 22 miles per hour and one stop every 0·88 mile. This service requires, as seen from Table 5, only 1·63 h.p. per ton of total weight of train. 1·63 h.p. of continuous equipment weighs only $\frac{1{\cdot}63}{11} = 0{\cdot}148$ ton. Consequently out of each ton of total train weight, only 14·8% will consist of electrical equipment as against the 32% seen from Table 4 to be required when the S.L.E. service is provided by a train equipped with single-phase apparatus. Let us again represent by W the total train weight in tons. Then the weight of the electrical equipment in tons amounts to 0·148 × W. The weight of the Southport train, exclusive of the electrical equipment, is 118 — 30 = 88 tons. Consequently $W = 0{\cdot}148 \times W + 88 = 103$ tons. The weight of the electrical equipment of the revised Southport train, that is, of the continuous train capable of working to the relatively moderate S.L.E. service, is only 0·148 × 103 = 15·3 tons, or only 51% of the 30 tons weight of the electrical equipment required for the Southport train performing the severe Southport service. Obviously then, were we to operate a 180-ft. train to the S.L.E. schedule, employing continuous equipment instead of single-phase equipment, we should not require two motor-coaches, but we should make up our three-coach train of one motor-coach and two trailers. The continuous equipment thus weighs only 15·3 tons, or only 34·8% of the 44 tons required for the single-phase train of equal length. It is interesting to note that this continuous-electricity train operating on the S.L.E. service is only required to give an average output of 15·3 × 11 = 168·5 h.p., which amounts to only $\left(\frac{168{\cdot}5}{225} =\right)$ 75% of the average output required of the motors on the single-phase 138-ton S.L.E. train.

COST ESTIMATIONS.

A rough but thoroughly representative figure for the cost of continuous equipment for railways is £125 per ton. Single-phase equipment at present costs decidedly more, but for the purposes of this investigation the author will take the cost of the electrical equipment, irrespective of whether it is continuous or single-phase, at £125 per ton. Thus for the four trains under consideration, the costs for the electrical equipment work out as follows:—

Electrical Equipment of one train		Weight.	Cost per ton.	Total cost.
		Tons.	£	£
Continuous train for..	Southport service	30	125	3,750
,, ,, ,,	S.L.E. service	15·3		1,910
Single-phase train for	Southport service	77		9,630
,, ,, ,,	S.L.E. service	44		5,500

As to the cost of the remainder of the train, the estimates will be based on the following data:—

BOGIE-TRUCKS.

The weight of each motor-truck, including truck-frames, wheels, axles, brake-rigging, etc., will be taken at 6·5 tons, the weight of each trailing truck at 5·5 tons. In both cases, the cost of the complete trucks will be taken at £22 per ton.

The weight of all the trucks is:—

For a train comprising 3 motor-coaches and no trailer (12 driven axles)—39 tons.

For a train comprising 2 motor-coaches and 1 trailer (8 driven axles)—37 tons.

For a train comprising 1 motor-coach and 2 trailers (4 driven axles) —35 tons.

The cost of the trucks for these three trains is:—

Three	motor-coaches	and	no trailer,	£860
Two	,,	,,	1 ,,	£815
One	,,	,,	2 trailers,	£770

The weight of the three coach-bodies, complete with underframes, brake-cylinders, upholstering, etc., is:—

Continuous train for	Southport service,	118—30·0—37 = 51·0 tons.
,,	,,	S.L.E.	,,	103—15·3—35 = 52·7 ,,
Single-phase	,,	Southport	,,	171—77·0—39 = 55·0 ,,
,,	,,	S.L.E.	,,	138—44·0—37 = 57·0 ,,

For an absolutely consistent comparison, these four cases should have all worked out at the same value as regards the aggregate weight of the three coach-bodies. They are, however, so nearly identical (varying only 6% from the mean value), that their mean value may be taken as representative for the weight of the coach-bodies of a 180-ft. train for this type of service.

The mean value is 54 tons, or $\frac{54}{3} = 18$ tons for each coach-body.

These coach-bodies, complete, may be taken as costing £80 per ton. Thus for all four trains the aggregate cost of the three coach-bodies (weighing 54 tons) will be 80 × 54 = £4,320.

The costs of assembling, and all further costs, will be taken at £5 per ton of train. These further costs are, consequently, for the four trains:—

Continuous train for	Southport service,	5 × 118 = £590.
,,	,,	S.L.E.	,, 5 × 103 = £515.
Single-phase	,,	Southport	,, 5 × 171 = £855.
,,	,,	S.L.E.	,, 5 × 138 = £690.

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The total costs of the four trains are made up as shown in Table 6 :—

TABLE 6.

	Continuous Train.		Single-phase Train.	
	For Southport service.	For S.L.E. service.	For Southport service.	For S.L.E. service.
	£	£	£	£
Trucks	815	770	860	815
Car bodies	4,320	4,320	4,320	4,320
Electrical equipment	3,750	1,910	9,630	5,500
Further costs ..	590	515	855	690
Total cost of train ..	9,475	7,515	15,665	11,325
Weight of train ..	118 tons	103 tons	171 tons	138 tons
Cost per ton.. ..	£80·3	£72·7	£91·6	£82·1
Length of train ..	180 ft.	180 ft.	180 ft.	180 ft.
Cost per foot ..	£52·6	£41·7	£87·0	£63·0
Weight per foot ..	0·655 ton	0·575 ton	0·95 ton	0·77 ton

Since these trains have a seating capacity of, roughly, one seat per foot, the two lower horizontal lines in Table 6 also give a fair representation of the relative costs and weights per seat. We see that for so severe a service as that at Southport, the cost of a single-phase train $\left(\text{since } \frac{87{\cdot}0}{52{\cdot}6} = 1{\cdot}65\right)$ works out to be 65% greater per foot of length than is the cost of a continuous train. For the much more moderate service of the S.L.E. line, the excess cost of the single-phase train per foot of length is only 51% $\left(\text{since } \frac{63{\cdot}0}{41{\cdot}7} = 1{\cdot}51\right)$, and the percentage continues to fall with every amelioration in the severity of the service.

It is usually preferable to reduce weights and costs to the basis of the weight and cost per foot length of train instead of per seat. Otherwise it is very difficult to effect comparisons, for not only have we to take into account the varying composition of trains as regards first and third-class carriages, but there is the further consideration that the policy of railways differs considerably as to the floor-space and elbow-room which are allotted to each passenger. Since, however, the average value of the seats per foot for representative passenger trains of mixed composition rarely varies much from unity, the values of the weight and cost per foot enable us to readily make mental calculations, as occasion requires, of the corresponding weights and costs per seat. It is preferable, in all cases, to take the weights of the trains themselves, and to leave out of consideration the weights of the passengers.

THE COST OF THE ENERGY CONSUMED AT THE TRAIN.

We have now deduced fairly definite values for the weights and costs of the rolling stock. The component of the total cost represented by the electricity consumed by the train is also fairly definite for a given service. The consumption at the train is for a given service about the same per ton-mile whether the electrical equipment be continuous or single-phase. The values in Table 7 afford a reasonable basis for estimating the consumption at the train per ton-mile of actual performance, when the train is handled by a fairly experienced driver and when it is running strictly to its time-table, and over a well-built, fairly straight and level permanent way. Although quite practicable variations in the acceleration and braking may easily occasion variations of 10% or more in the energy consumption at the train, nevertheless the values in Table 7 are representative of the customary results obtained under the conditions stated.

In the case of passenger trains it is preferable for uniformity's sake to estimate the ton-mileage on the basis of the weight of the emply train. The unrecorded ton-mileage corresponding to the weight of the passengers carried, together with that corresponding to shunting operations and other non-remunerative running, as well as the increased consumption on occasions when the time-table is disarranged, will usually bring up the total consumption at the train to a value some 30% greater than the values given in Table 7. This increase is only in small part due to the weight of the passengers, since with average loads, the weight of the passengers rarely increases the weight of the train by more than some 5 to 6%. In the following estimates the author will take the consumption of electricity at the train as 1·30 times the values in Table 7. To simplify the investigation he will not go into the question of whether the railway provides its own generating plant or purchases the electricity from a supply company ; but he will merely assume that the electricity is obtained at a total cost of 0·65d. per kw.-hour as delivered to the sub-stations. Owing to the greater loss in transformation at the sub-stations and the greater cost of the sub-stations, in the continuous, as contrasted with the single-phase system, he will take the cost of the electricity as delivered from the sub-stations at 0·70d. per kw.-hour for the single-phase system and at 0·87d. per kw.-hour for the continuous system. These amounts cover all outlays, both capital and operating,

TABLE 7.*

Schedule speed in miles per hour.	Energy Consumption in watt-hour per Ton-mile for the various values of the distance in miles between stops set forth at the heads of the vertical columns, and for 20-second stops.							
	0·5	0·6	0·7	0·8	0·9	1·0	1·25	1·5
15	68	58	50	—	—	—	—	—
16	78	66	56	50	—	—	—	—
17	93	76	63	55	50	—	—	—
18	114	90	73	62	55	48	—	—
19	—	104	83	70	60	53	—	—
20	—	—	94	78	66	58	47	—
22	—	—	—	95	77	67	54	—
24	—	—	—	—	98	83	65	55
26	—	—	—	—	—	100	78	63
28	—	—	—	—	—	—	89	73
30	—	—	—	—	—	—	104	82

up to the outgoing cables from the sub-stations. The losses in the transmission system from the sub-stations to the trains are of but small amount in either system. To allow for them he will take the cost of the electricity delivered at the trains as 0·72d. per kw.-hour for the single-phase system, and 0·90d. per kw.-hour for the continuous system. These last increases in the cost simply allow for the electricity wasted in the process of being conveyed from the sub-stations to the trains, and do not allow for the capital and maintenance charges for the cables and the conductor-rails or overhead structures by means of which the electricity is conveyed from the sub-stations to the trains. The two figures of 0·72d. and 0·90d. per kw.-hour respectively are thoroughly representative as regards their relative values, though their actual values, while representative, will vary considerably according to many local circumstances.

Furthermore, these values are only applicable for the conditions of a suburban service of passenger trains where the trains in each direction run, as an average, at intervals of some twelve to fifteen minutes during some sixteen to twenty hours per day. For a less intense service, the price for continuous electricity will exceed that for single-phase electricity by a greater percentage, since the cost of the sub-stations will constitute a larger item, and the "all-day" efficiency of the sub-stations will be less. If, on the contrary, the trains run at intervals of only some three to six minutes, then also the relative figures of 0·72d. and 0·90d. at the trains are not applicable ; 0·69d. for the single-phase system, and 0·83d. for the continuous system, would then be more appropriate, the latter in this case exceeding the former by only 20% as against 25% in the case of the twelve to fifteen-minutes' service. This is because, while the cost of the electricity, as delivered at the trains, in the case of both systems, decreases with the intensity of traffic, the decrease is a greater amount for the continuous system, owing to the better load-factor at the sub-stations and the consequent considerable reduction in the capital charges and operating expenses of the sub-stations. For his further comparisons, however, the author will take the figures of 0·72d. for the single-phase system and 0·90d. for the continuous system for the cost of electricity per kw.-hour delivered at the trains.

With these data, we may now estimate the cost of the electricity consumed by 180-ft. trains operating to the Southport service (as an instance of a severe service) and to the S.L.E. service (as an instance of a much more moderate service). The price actually paid for the electricity for the S.L.E. trains is, at present, decidedly higher than the figures here taken, but the fairly high price in that instance is probably, to some extent, incidental to the experimental nature of the undertaking at this stage. It is well known that in most districts there would, under the conditions already indicated, be reasonable profit in supplying railways with electricity at the prices stated, and hence it is only on the basis of such prices that the comparisons will lead to useful results.

To fix ideas, it can be taken that the author's figures relate to a hypothetical road so situated that his prices for electricity are applicable, and have been quoted, and that the engineers of this road are engaged in determining :—

(1st.) Whether to use the continuous or the single-phase system.

(2nd.) The schedule speed to be provided on various sections of line with various distances between stations.

Prior to making some detailed estimates, the engineers of this railway will first arrive at some general comparative results, as follows :—

Let the comparison relate to four cases, I, II, III and IV. The general particulars of these cases are set forth in Table 8.

* In the author's opinion the energy consumption per ton mile is, for frequently-stopping trains, very much less dependent upon the weight and length of the train than is generally believed. It would be too irrelevant to the present discussion to enter upon the consideration of this point further than to state that the energy-consumption values in Table 7 are consistent for test runs with trains coming within the range of lengths and weights considered in this Paper.

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TABLE 8.

Designating Number.	Length of train.	Average distance between stations.	Schedule speed.	System.
	feet.	miles.	m.p.h.	
I.	180	1·32	30	Continuous
II.				Single-phase
III.	180	0·88	22	Continuous
IV.				Single-phase

Out of the 8,760 hours in the year, it is rarely practicable, on other than Tube railways or railways providing the class of service associated with Tube railways, to attain (for suburban passenger trains) to much more than 2,000 hours of actual service on the line. Usually the figure is decidedly less than 2,000 hours.

For a schedule speed of thirty miles per hour, the profitable mileage per train per annum, on the basis of 2,000 hours, works out at 60,000 miles, and for a schedule speed of twenty-two miles per hour it works out at 44,000 miles. Under the conditions of actual service, there will not be so much difference as this between the annual average mileage per train, for these two schedules. The more the service conforms to the conditions of a tramway service, the more uniform and continuous will be the sequence of trains; consequently, for the twenty-two miles per hour case the author will take the annual average mileage per train at 48,000 miles instead of the above 44,000 miles, and for the thirty miles per hour case he will take the annual average mileage at 54,000 miles instead of the above 60,000 miles.

The total cost of electricity per annum per train is obtained as shown in Table 9.

Questions relating to the depreciation, maintenance and renewals of trains are of so wide-reaching a nature that it would be inappropriate to deal with them in this brief Paper. For comparative purposes, however, the author does not believe that the instructiveness of his results will be impaired, if he takes at the rough figure of 15% of the cost of the rolling stock, the annual charges for interest, depreciation, repairs and renewals. He will term these the annual charges for capital, depreciation, repairs and renewals per train, and as a check to indicate their general reasonableness, he will, in Table 10, also work out the corresponding values per train-mile.

In Table 11 are brought together the results of Tables 9 and 10.

Amongst the many and large remaining costs, there are none in which the adoption of the continuous system will entail greater costs per train than are incurred with the single-phase system.

TABLE 9.

Schedule speed miles per hour	30		22	
Distance between stops miles	1·32		0·83	
Designating number	I.	II.	III.	IV.
System	Continuous	Single-Phase	Continuous	Single-Phase
Weight of train (from Table 6) tons	118	171	103	138
Net consumption of electricity at train in w.-hr. per ton-mile (from Table 7)	96	96	79	79
Do. in kw.-hr. per train-mile	11·3	16·4	8·2	10·9
Miles per train per annum	54,000	54,000	48,000	48,000
Net consumption per train per annum (kw.-hr.)	610,000	886,000	394,000	523,000
Gross consumption per train per annum (=1·30 × net consumption) kw.-hr.	793,000	1,150,000	512,000	680,000
Cost of electricity delivered at train, per kw.-hr. d.	0·90	0·72	0·90	0·72
Total annual cost per train for electricity £	2,970	3,450	1,920	2,040
Do. per train-mile d.	13·2	15·3	9·6	10·2

It is well known that the gross receipts for three-coach trains on services of this character, are usually of the order of from 40d. to 60d. per train-mile. Let us fix our attention on a case where the gross receipts are 50d. per train-mile. It is evident from the results in the lowest horizontal line of Table 11 that in such a case, whatever be the net profits, they will be less if the single-phase system is used than if the continuous system is used. The percentage of the gross receipts which could be set aside as profits, would, for the 30 miles per hour, one-stop per 1·32 mile service, be $\frac{6·22 \times 100}{50} = 12·45\%$ greater with the continuous than with the single-phase system. For the 22 miles per hour, one stop per 0·88-mile service, they would still be greater by $\frac{3·5 \times 100}{50} = 6·7\%$. It is common knowledge that suburban traffic is at present very unremunerative, although

TABLE 10.

Schedule speed miles per hour	30		22	
Average distance between stops .. .. miles	1·32		0·88	
Designating number	I.	II.	III.	IV.
System	Continuous	Single-Phase	Continuous	Single-Phase
Total cost of train (from Table 6) .. .. £	9,475	15,665	7,515	11,325
Percentage taken for obtaining annual capital charges per cent.	15	15	15	15
Annual charges per train for capital, depreciation, repairs and renewals £	1,420	2,350	1,130	1,700
Do. per train-mile .. d.	6·31	10·43	5·65	8·55

this is not always obvious from balance sheets where the profits shown are usually very largely from main-line and goods traffic. Confining our attention to the suburban traffic, it appears that while there may be a few services in which the margin in favour of electrification is great enough to stand the higher cost of the single-phase system, there are many in which the great difference which the author has shown as existing between the two systems would make all the difference between commercial success and commercial failure.

The subject is a large one with many important aspects. This investigation, however, clearly shows that the selection of the electrical system and also the determination of the service to be provided, as regards schedule speed, distance between stations and intensity of traffic, are all matters demanding the most

TABLE 11.

Schedule speed miles per hour	30		22	
Average distance between stops .. .. miles	1·32		0·88	
Designating number	I.	II.	III.	IV.
System	Continuous	Single-Phase	Continuous	Single-Phase
Total annual cost per train for electricity .. £	2,970	3,450	1,920	2,040
Annual charges for capital, depreciation, repairs, and renewals, per train £	1,420	2,350	1,130	1,700
Sum of above two annual outlays, per train £	4,390	5,800	3,050	3,740
Cost per train-mile, for electricity .. .. d.	13·2	15·3	9·6	10·2
Annual charges for rolling-stock, per train mile d.	6·31	10·43	5·65	8·55
Sum of above two outlays per train-mile .. d.	19·51	25·73	15·25	18·75
Amount by which the single-phase train costs more per train-mile than the continuous-electricity train d.	6·22		3·5	

careful attention and that they are interdependent. It is evident from the nature of the case, as illustrated by the problems the author has worked out, that the more severe the service and the more intense the traffic, the greater is the superiority of the continuous system. But it is also demonstrated that even for systems of such moderate severity as 22 miles per hour and one stop per 0·88 mile, and even when the intensity of traffic is only one train every 12 to 15 minutes in each direction, the superiority of the continuous system is still very substantial. It is, however, precisely for intense traffic and for severe services, that is, for services exceeding the limits amenable to steam-locomotive methods, that electricity is pre-eminently applicable.

A point of considerable interest, disclosed by a comparison of the values in the penultimate horizontal line in Table 11, is that, with the continuous system, the components of the total cost per train-mile, which he has considered, are 28% greater (since $\frac{19·51}{15·25} = 1·28$, for the 30 miles per hour, one stop per 1·32 mile service, than for the 22 miles per hour, one stop per 0·88 mile service, while with the single-phase system, the cost

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per train-mile is 37% greater (since $\frac{25{\cdot}73}{18{\cdot}75} = 1{\cdot}37$) for the former than for the latter service. This is another point of view from which the greater appropriateness of the continuous system for severe services is apparent.

With the object of basing his comparisons on thoroughly authenticated cases, the author has taken for the continuous-electricity services, roads employing pressures of some 600 volts at the trains. There are, however, now a considerable number of roads employing a pressure of 1,200 volts with conspicuous success; indeed, in some of these instances, single-phase equipments have been replaced by 1,200-volt continuous-electricity equipments. As early as 1904 the author urged the advantages of doubling the customary pressure for continuous-electricity traction systems, and based his comparisons on the precise lines which are now being so successfully adopted. Upwards of a dozen roads have now adopted the 1,200-volt continuous-electricity system of traction. This system effects distinct economies over the 600-volt system and very appreciably accentuates the contrast between the continuous-electricity system and the single-phase system.

IDO AND THE SCIENTIST.

Important Steps towards a Practical International Language.

By Spenser Sarle.

From the purely logical standpoint, it must be regarded as a remarkable circumstance that hitherto the wit of man has not succeeded in devising an adequate medium through the agency of which all the nations of the world, and particularly all the scientists of the world, can make themselves mutually understood. The evolution of an international language has long been the dream of the scientist, as of the literary man, and, in perhaps a lesser degree, of the merchant. Just as maritime peoples have agreed upon a common code of signals, and telegraphists have been enabled to adapt the Morse Code to practically every tongue, the scientist has sought a method of framing his conclusions and discoveries in such a form that scientists of all other countries can share in them and aid in their elucidation and codification. Is it altogether a dream, or are there conditions which will serve to bring such a common language into actual being? There were sixty artificial languages before Volapük which Volapük outpaced just as Esperanto has outpaced Volapük, and the logical deduction is that further effort will bring about the evolution of an international auxiliary which will similarly outpace Esperanto. There has, indeed, been a step taken recently which brings us nearer than we have ever been before to the realisation of this ideal.

Ten years ago an International Commission under the title of the *Déléyation pour l'Adoption d'une Langue Auxilaire Internationale* was entrusted with the task of investigating the whole question of a world-language. Their report, which has just been issued, demonstrates that there is, without the shadow of a doubt, a sound idea lying at the root of the movement, and having arrived at this conclusion, the Commission, which was composed of scientific and literary men of international repute, set themselves the task of proving their position by the actual construction of such an auxiliary language. Examining with scrupulous care the system and machinery of earlier schemes, they worked out on purely scientific principles an international auxiliary on the basis of Esperanto.

This stage was not arrived at without long, anxious and exhaustive discussion. The Delegation had to consider in the first instance whether there was any reasonable hope of reinstating Latin in the position it once held as a common language. But Latin, apart from its decline in the spread of popular education, was found incapable of expressing the ideas of science in its more modern development. Nor, for reasons of national sentiment, could any individual knowledge of three such languages, for instance, as German, French and English suffice, for at least five other tongues would need to be taken into account. Another consideration was the possibility of effecting the exclusion of classical languages from schools and the substitution of modern tongues; but here educationists of all nations were at once at issue, and other weighty considerations put the suggestion out of court. Then came the question: Could one of the national languages be chosen for the purpose of science as a world-language? Here, again, national sentiment proved the stumbling block. In short, the Commissioners were irresistibly driven, after prolonged debate, to the conclusion that an artificial language was the only possible solution of the problem—an artificial, but not a new language; in effect a language consisting chiefly, if not wholly, of words known to every educated person.

How this step was arrived at is related in a notable book which has just been published by Messrs. Constable & Company, Ltd., in which important papers by Professors Couturat (Caen), Jespersen (Copenhagen), Lorenz (Zurich), Ostwald (Leipzig), and Pfaundler (Graz), are ably translated and set forth by Professor F. G. Donnan, of Liverpool University. In his preface to the collection of papers, Professor Donnan strikes a note which at once compels sympathetic attention. The scientific attitude of mind, he says, is necessarily critical, but never sceptical without proper investigation and knowledge, and he expresses the earnest hope that English-speaking men of science will not judge the question of international language before they have quietly and dispassionately examined the arguments set forth. "It is not a question of 'another language'; it is a question of the final solution by the methods of science of one of the greatest of scientific problems. Internationalisation of thought is the motto of the twentieth century, the device on the banner of progress. Science, the Super-Nation of the World, must lead the way in this as in all other things. Amidst the clangour and the clamour of political and commercial strife, the quiet empire of knowledge grows, noiseless and unseen. Let all those," urges Mr. Donnan, "who believe that this peaceful empire is destined to become the controlling force of the world assist in the attunement of its common language."

What are the conditions of this attunement? The Delegation laid down three essential propositions for an international language: (a) It must be capable of serving the needs of science as well as of daily life, commerce and general intercourse; (b) it must be capable of being easily learnt by all persons of average elementary education; and (c) it must not be any one of the living national languages. Proceeding on this basis they arrived at the formula that "that international language is best which offers the greatest facility to the greatest number"; at the canon (with some modifications) of "one symbol, one sound"; and at the essential principle that "every word element shall represent an elementary idea which is always the same, so that a combination of elements shall have a meaning determined by the combination of the corresponding ideas." From this step to the principle that the international language shall adopt for each idea the stem familiar to the greatest number of people, is easy, and there follows the conclusion that in its formation of words the international language must be autonomous, combining freely, according to its own rules, the borrowed elements, but preserving rigorously their form and sense.

In this way the international language would become, in its system of derivation and in its structure, "a purified and idealised extract, a quintessence, of the European languages"; not only a medium of communication between all countries, but an instrument of precision for the analysis and expression of forms of thought, freed from all ambiguity. In its application to science there must be in it no such failure as the famous Esperanto example in which the sentence "a rotary transformer might be called a motor-generator, but the latter name is usually applied to machines with independent armatures," becomes *Turnighan alispecigilon oni povas nomi motorproduktanto*, which, literally translated, means "a self-turning otherwise-making instrument can be called a motor producer!"

Avoiding these Esperantist pitfalls and bearing steadfastly in mind the principles here briefly summarised, the Commission framed the international language provisionally known up to the present moment as "Ido"—"a descendant" in fact, of Esperanto. The construction of this language has probably occupied, from first to last, a good deal more than the seven years during which the Commission has been sitting, and it may now be regarded as having been brought into the world full-armed. So far as we have been able to examine it, Ido seems calculated admirably to fulfil its purpose. It is, of ocurse, not yet complete, though already a journal is printed in the new auxiliary, as well as a

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grammar and lexicon. Completeness can only come with further discussion and co-operation, and it is with the hope of furthering this discussion and co-operation among the members of the profession and industry with which THE ELECTRICAL ENGINEER is chiefly concerned that this article has been penned.

To give a sketch of the language itself would be impossible in the space at our disposal, but we may extract, in the first place, a few paragraphs indicating the lines on which it is constructed, and also an example of the ease and accuracy with which it can be translated and retranslated. In an appendix to the volume under notice some of the essential features are set forth as follows :—

Pronunciation.—All letters are pronounced, and have always the same sound : a (as in father), c (like ts), e (like e in set, or a in fate), g (always hard as in go), i (like ee in sweet), j (either as in English, or like the French j in journal), o (like o in not or like o in go), q (qu as in English, or like kv), s (unvoiced), u (like oo in too), x (like ks or gz), y (as in English), z (as in English), ch (as in church), sh (as in English), au (like ow in how), eu (e-u). It will be seen that a certain amount of latitude is permitted, in order to suit the convenience of different nations. The stress is on the penultimate syllable, except in the infinitive, when it falls on the last syllable (ar-ir, -or). Since y is a consonant, it does not count as a separate syllable (fluvyo).

Definite Article.—La, for all genders and numbers.

Substantive.—Ends in -o in the singular, in -i in the plural.

Adjective.—Is invariable and ends in -a.

Personal Pronouns.—Me—I, tu—thou, vu—you (singular), il—he or it (masculine), el—she or it (feminine), ol—it (thing) ; ni—we, vi—you (plural), li—they (all genders). If distinction is necessary, ili—they (masculine), eli—they (feminine), oli—they (neuter).

Possessive Pronouns.—Mea—my, mine, tua—thy, thine, vua—your, yours (singular), sa—his, her, hers, or its ; nia—our, ours, via—your, yours (plural), lia—their, theirs. In the plural the ending -i is substituted for -a when the above words are used as true possessive pronouns.

In another appendix we are given an example of the ease and accuracy with which Ido can be translated. Here is a portion of an essay by Professor W. James on " The Laws of Habit " :

So far as we are thus mere bundles of habit, we are stereotyped creatures, imitators and copiers of our past selves. And since this, under any circumstances, is what we always tend to become, it follows first of all that the teacher's prime concern should be to ingrain into the pupil that assortment of habits that shall be most useful to him throughout life. Education is for behaviour, and habits are the stuff of which behaviour consists.

Here is the same passage translated into Ido by Professor Couturat :

Segun quante ni esas tale pura faski de kustumi, ni esas stereotipita kreuri, imitanti e kopianti di nia propra pasinto. E pro ke co, en omna supozi, esas to, quo ni sempre tendencas divenar, konsequas, unesme, ke la precipua skopo di l'instruktisto devas esar inkrustar en la lernanto ta asortajo de kustumi, qua esos max utila ad il tra sa tuta vivo. L'eduko esas por la konduto, e la kustumi esas la materyo, en qua la konduto konsistas.

And here is the English version of the Ido translated by M. Hugon, who was wholly unacquainted with the original :

Inasmuch as we are thus pure bundles of habits, we are stereotyped creatures, imitators and copyists of our own past. And because this, in any case, is what we always tend to become, it follows, in the first place, that the teacher's chief object must be to incrust in the learner that set of habits which will be most useful to him throughout his whole life. Education makes for conduct, and habits are the material which conduct consists of.

In order to establish the new auxiliary there has been formed an organisation with a title sufficiently explanatory of its object, of which the Secretary is Herr A. Waltisbühl, 46, Bahnhof-strasse, Zürich. The Provisional Statutes of this Union set forth that the sole purpose of the *Uniono di l'Amiki di la Linguo Internaciona* is to unite, for the purpose of common action, all persons who recognise and approve of the idea of an international language in the form given to it by the Delegation. The Union accepts as the international auxiliary language the *Linguo internaciona di la Delegitaro* resulting from the labours and decisions of the commission and the working committee of the Delegation, but expressly declares that this language is not to be regarded as " perfect " and " infallible." On the contrary, it takes the view that the language is capable of continuous improvement according to the principles resulting from the work of the Delegation.

The Union consists of members of both sexes of all nationalities who are willing to learn the lanugage, to employ it on all suitable occasions in intercourse with foreigners, and to take part in its propagation, and the yearly subscription amounts to 1·25 francs, or one shilling, or one mark, or 1·20 krone (Austrian), while permanent membership is obtained by a single payment of 50 francs, or its equivalent.

The volume " International Language and Science," in which all these matters are set forth, is published by Messrs. Constable & Company, Ltd., 10, Orange-street, Leicester-square, at 2s. net.

[A copy of the book will be sent post free to any country in the Postal Union by the Manager of the " Book Department," ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C., on receipt of 2s. 3d.]

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

Question No. 1224.—What is the principle of the new tube lighting now being tried at the Bradford Town Hall ? What is its efficiency compared with metal or carbon lamps ? Can wool be sorted and patterns matched properly with this light ? If the voltage be 2,000, what will the Board of Trade say to that in the ordinary sorting room of a factory ? Are there interlocking and earthing devices on the market to ensure safety for such as a " MILL ELECTRICIAN."

Question No. 1225.—In starting up a 50 h.p. squirrel-cage motor (3-phase, 400 volts, 50 ~) by an auto-starter the rush of current is so large as to lower all the lighting on the generator. Is there any cheaper way (besides slip rings) of getting over this trouble.—" M. E."

ANSWERS.

Question No. 1220.—Compressed air, water-power and electric power are all available for a certain foundry. Which should be used to get cheapest, most reliable and most flexible supply ? Please note valve and pipe troubles and remedies and the relative pipe and engine sizes for compressed air and hydraulic power. Compare compressed air and steam for cases in which fairly long pipes are required ; also compare air and water pipes as regards leakages, etc. Over what distance is each system of power transmission available and what is usual best limit ?

Answer to Question No. 1220 (*awarded* 10s.).—Foundry conditions are not favourable to the use of electric motors ; the all-pervading heat and dust are alike injurious to the insulation and to the commutator condition of the machine. Where electric motors are employed the totally enclosed type is, of course, essential. For ordinary foundry work, however, I should recommend the use of compressed air or water power for stationary machines. The flexibility of electric power is conveniently adapted to any case in which a temporary supply is required at any spot ; the more inaccessible and remote the latter the greater the advantage of an electric motor over a temporary compressed air or hydraulic equipment. The portable electrically driven air compressor is a most useful foundry adjunct ; the cable

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forms a flexible, safe and efficient trailing source of power supply, none of which qualities are readily obtainable in the case of pneumatic or hydraulic power schemes. Flexible compressed air lines, however, stoutly armoured (while preserving reasonable flexibility) soon develop leaks. I have often seen large hissing leaks temporarily repaired and run for hours on end by the primitive and not particularly effective expedient of a tight rag bandage—this, too, in a large " well found " coalfield. Hydraulic power is doubly unsuitable for portable or temporary work; no reasonably flexible trailing pipe will stand the pressures usual in hydraulic work, and, unlike compressed air machines, some provision has to be made for conveying the " exhaust " to waste.

For stationary machines served by permanent power supply, hydraulic possesses the important advantage over pneumatic working that much smaller pipes and engine cylinders can be used; the hydraulic system is usually the more efficient owing to its direct action and independence of all thermal considerations; the latter cannot be properly cared for in a foundry plant. Hydraulic pressures are of the order of 700-1,500 lbs. per sq. in., while compressed air is seldom carried above 100 or 200 lbs. per sq. in.; the water engines therefore operate under a pressure at least 4-10 times as great as that of the pneumatic plant, hence, for equal duty under similar conditions, the hydraulic pipes and cylinders need only be 0·3 – 0·5 × the diameter of those in the pneumatic installation (in many cases the saving is still greater).

Even large moulding machines when hydraulically operated can be served by a ½ in. pipe; now copper can be used for such a pipe, and hence all corners can be negotiated by bending the pipe. The number of joints is, therefore, a minimum, and leakages become far less frequent. Air pipe lines, on the other hand, must be much larger, and hence iron must be used in their construction. Every bend then requires an elbow piece, and these, together with the increased number of straight joints, involve considerable risk of leakage; the installation of the rigid iron pipe lines is also a more costly matter.

It is quite practicable, with care, to keep an air pipe line sufficiently tight for all practical purposes. As an offset to the larger pipe diameters and increased number of joints the line is less affected by cold weather (apart from freezing) than is a water line: leakages are, however, more easily located in the latter.

The Princess Furnace Company (Glen Wilton, Virginia), use 8,000 ft. of 5 in. compressed air piping in one cross-country transmission scheme. Sleeve couplings and expansion joints are provided, and there are no serious troubles by leakage. In another American scheme a pipe line is exposed to 50° F. below zero in winter and to 110° F. in summer, and yet remains so tight that the pressure only falls about 10 lbs. per sq. in. below normal during a 48 hours off-duty spell. On the whole, however, hydraulic lines are more easily kept tight. Metal seated valves will always give trouble in hydraulic apparatus; a leather packing is almost essential for satisfactory working. In ordinary types of valves such leather packing is rapidly torn and cut by the edges of the valve parts, but a poppet type of valve with leather seatings obviates this danger.

A relatively serious leak in the pipe line can be more effectually temporarily stopped in a pneumatic system than in a hydraulic scheme—largely on account of the much lower pressure employed. This point is of importance in some cases where uninterrupted power supply is vital.

Where a permanent power supply is required (*e.g.*, at a stationary machine) it is seldom advisable to use electric transmission with an air compressor close to the work; this system only becomes advisable for stationary demands when the distance of transmission is 2-3 miles or upwards. Individual cases vary so much that in some cases a combined electric and pneumatic plant is cheaper both capitally and in operation than a purely pneumatic system. Usually, however, the combined system is most applicable to temporary and portable services.

Steam pipe lines must be thoroughly lagged and even then suffer such losses by condensation as to make pneumatic or hydraulic power transmission far preferable for distances greater than, say, ⅛-¼ mile. The expansion troubles are greater in a steam line than in either of the alternative pipe systems; when a leakage occurs in a steam joint the escaping steam partially condenses, the particles of moisture then acting as an abrasive and causing the well known " eating " or " corroding " of the flange metal.

Electrical power transmission is efficient, without any voltage elevation, for distances up to 5 miles; hydraulic power transmission is satisfactory up to 3 or 4 miles; pneumatic lines are apt to give trouble if much over 2 miles long; steam piping, however carefully lagged, should not be carried over greater distances than 200-400 yards if at all avoidable.—" KITTY."

FINANCIAL NOTES.

WESTMINSTER ELECTRIC SUPPLY COMPANY.—The directors of the Westminster Electric Supply Company have declared an interim dividend for the half-year at the rate of 10% per annum, less tax.

* * *

MELBOURNE TRAMWAY AND OMNIBUS.—The London secretary of the Melbourne Tramway and Omnibus Company, Ltd., has received cable advice of the declaration of a bonus for the year ended June 30 last at the rate of 5% = 6d. per share, payable on August 17. Traffic receipts for July are £48,000; car miles run for July are 875,000.

* * *

BROMPTON AND KENSINGTON ELECTRICITY.—An interim dividend of 9% per annum (4s. 6d. per share) has been declared.

* * *

METROPOLITAN ELECTRIC SUPPLY.—The directors of the Metropolitan Electric Supply Company, Ltd., have declared an interim dividend at the rate of 4% per annum for the half-year to June 30.

* * *

LONDON STREET TRAMWAYS.—An extraordinary general meeting is called for August 10, to consider a resolution to distribute among the shareholders the balance of the available funds of the company. The return of capital will be approximately 8s. per share, in addition to 2s. per share (final dividend for the half-year ended June 30).

* * *

CHARING CROSS, WEST-END AND CITY ELECTRICITY SUPPLY.—The Charing Cross, West-End and City Electricity Supply Company, Ltd., have declared an interim dividend at the rate of 5% per annum on the Ordinary shares of the West-End undertaking.

* * *

THE SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER COMPANY, LTD.—The Transfer Books and Register of Members of this company will be closed from August 18 to 31, 1910 (both days inclusive) for the preparation of dividend warrants payable the 31st inst.

* * *

THE WASTE HEAT AND GAS ELECTRICAL GENERATING STATIONS, LTD.—The directors have resolved to pay an interim dividend at the rate of 5% per annum in respect of the half-year ending July 31, 1910, on the amount of the share capital called and paid up at that date; the dividend will be paid less Income Tax on August 31, 1910, to the shareholders registered in the company's books at August 21, 1910.

PERSONAL.

Mr. W. J. McDonald, chief clerk of the Colchester Corporation Tramways, having been appointed traffic superintendent on the Burton and Ashley Light Railway, the Committee have appointed Mr. E. P. Lister, of the Blackpool Corporation Tramways, to fill the vacancy at a commencing salary of £2 per week.

Major Phillip Cardew, of Godalming, formerly electrical adviser to the Board of Trade, left estate of the gross value of £30,332, including personalty of the net value of £10,925.

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UNITED STATES: Mr. E. Brandon, 27, Thames Street, New York.

CANADA: Messrs. Walsh & Stoer, Stair Building, Toronto.

IMPORTANT NOTICE TO ADVERTISERS.

Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents and Small Advertisements by 9 a.m. on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements, 24 words 1s. per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

Situations Vacant, 24 words 1s., three insertions 2s 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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IONIZATION AND INSULATION BREAKDOWN.

It is a little over a decade ago that Professor Townsend placed before the scientific world his theory of ionization by collision, and now he has added to the debt which both the physicist and the engineer owe him by publishing his book on "The Theory of Ionization of Gases by Collision." It has, as a matter of fact, advanced rather farther than the stage of being a "working hypothesis," and has attracted many of the keenest intellects of the day engaged both on theoretical and practical problems. The Professor remarks in his preface that the large effects that may be obtained by the multiplication of ions with comparatively small electric forces demonstrate that the process of ionization by collision is of enormous importance in the development of large currents. Moreover, it "affords an explanation of many phenomena in connection with the discharge of electricity through gases." As an instance of this, the author points out in Chapter III., when discussing the sparking potential in a uniform electric field, that when a potential difference is established between two electrodes in a gas, the gas behaves as a insulator until the potential exceeds a sharply defined value (the "sparking potential") when the insulation breaks down, and a comparatively large current, accompanied by a glow, passes through the gas. Now, it happens that while Professor Townsend's book was passing through the Press, Mr. J. B. Whitehead was applying the theory to unravel a very practical problem. In a paper on the "Electric Strength of Air," read before the twenty-seventh convention of the American Institution of Electrical Engineers, he remarked on the great value of air as a dielectric for exposed wires, but he showed that under certain conditions this insulation broke down, resulting in great loss, which was manifested by the production of corona. Little as we know about the laws underlying the production of the corona, it is firmly established the breakdown of air as an insulation is invariably accompanied by a more or less visible corona, and is attended by copious ionization. Mr. Whitehead's experiments go to prove that: (a) "ions may be drawn from the substance of the wire or terminal itself under the electric intensity;

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(b) the molecule of the gas may be disrupted by a separation of its two component charges by the intensity of electric field in which it finds itself; (c) a molecule of a gas may be ionized or separated into its component charges as a result of a collision between itself and another molecule or charged particle." The experiments certainly tend to prove, almost to demonstration, that it is to ionization by collision, or secondary ionization, that the starting of corona is due. It was found that various phenomena had their effect in lowering the dielectric value of air. It was found that atmospheric pressure had a less disturbing influence than variations of temperature, while dampness was inimical to high insulation, and and so was a dirty state of the wire. Breakdowns under lower electric pressure were more frequent with small than with large wires. Mr. Whitehead explains this by assuming, on sufficiently good evidence, that there are about 1,000 ions present in a cubic centimetre of air under normal conditions. This would give them a distance of one millimetre apart, and consequently as they vibrate near the surface of the wire, they would be brought into closer proximity the smaller the wire, with the result that collision becomes more imminent with a very slight increase of vibration. Accepting this theory, it is obvious enough that the critical voltage would necessarily be lowered by dirt and surface impurities, because they would bring about irregularity in the direction of vibration and so accelerate collision. It appears proved that the dielectric strength of air is independent of material of the wire or terminal. Both Professor Townsend and Mr. Whitehead agree that the application of alternating electromotive forces to the problems of ionization of gases require close investigation. The book which the Professor has just published is issued avowedly for this purpose, and to correct certain errors that have been put forward by some experimenters. As Mr. Whitehead truly says: "Corona formation and the laws which regulate it are of the first importance for electrical engineers, since corona is to be prevented both as a source of loss and an enemy of insulation." It is well that this intricate field of research is being taken up determinedly on both sides of the Atlantic.

WIRELESS TELEGRAPH COMPASS.

An American consul at Havre furnishes a detailed description of an invention, the work of Italian scientists, which is called "a standard compass actuated by Hertzian waves," by the use of which the captain of a ship can determine with rapidity and simplicity the direction of the station giving forth electric waves. In foggy weather a ship having the Hertzian compass can at a considerable distance discover the position of a ship sending forth electric waves, thus minimising the danger of collision.

Up to the present there was no instrument which in a fog would enable a captain going into dock to fix the position of his ship or find out if the way were free; he had to trust to sounding and reduced speed; but with a Hertzian compass he could dock in complete safety if he followed the indicated directions of the compass. The Hertzian compass represents a means of great importance in preventing maritime accidents and in carrying help to ships in distress.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 148, Fleet Street, London, E.C.

CONTRACTS.

SKIPTON URBAN DISTRICT COUNCIL.

The Council invite Tenders for the supply of a GAS ENGINE and DYNAMO and the necessary WIRING, etc., for the lighting by electricity of the large hall in the Town Hall, Skipton. Particulars may be obtained from Mr. A. E. W. Aldridge, Surveyor to the Council, Town Hall, Skipton, and tenders endorsed "Gas Engine," are to be sent to him on or before August 17, 1910.

RICHARD WILSON,
Clerk to the Council.

August 5, 1910.

TENDERS FOR INSTALLATION OF WIRELESS TELEGRAPHY within the DOMINION of NEW ZEALAND.

General Post Office,
Wellington, May 23, 1910.

Tenders indorsed "Tender for Installation of Wireless Telegraphy within the Dominion of New Zealand" will be received by the Minister of Telegraphs, General Post Office, Wellington, up to noon of December 15, 1910, for the supply and erection at the following places of installations of wireless telegraphy in accordance with Specification and General Conditions:—

(1.) At or near Doubtless Bay.
(2.) At or near Gisborne.
(3.) At or near Cape Farewell.
(4.) At or near Sumner, near Christchurch.
(5.) At or near Bluff.

Specification and General Conditions and "Form of Tender" may be obtained at the office of the Superintendent of Electric Lines, General Post Office, Wellington; the office of the High Commissioner, 13 Victoria-street, London; and also from

(1.) Messrs. R. W. Cameron & Company, 23, South William-street, New York, U.S.A.;
(2.) H. Stephenson Smith, Esq., 244, California-street, San Francisco, Cal.

Tenders must be made out on the "Form of Tender," and must be accompanied by a deposit or receipt for a deposit as required by the General Conditions.

Deposits on tenders must accompany the tenders in the form of a bank draft, or the deposit may be banked. The banker's certificate must be forwarded with the tender, but it must be approved by the High Commissioner, London; or by

(1.) Messrs. R. W. Cameron & Company, 23, South William-street, New York, U.S.A.; or by
(2.) H. Stephenson Smith, Esq., 244, California-street, San Francisco, Cal.;

and must be to the effect that the amount of the deposit is held at the call of the Minister of Telegraphs.

Tenderers must state the name of the country in which the apparatus, etc., will be manufactured.

The Minister of Telegraphs does not bind himself to accept the lowest or any tender.

Tenders must be addressed to the Minister of Telegraphs, General Post Office, Wellington, New Zealand. If sent by post they must be prepaid and be registered.

J. K. LOGAN,
Superintendent of Electric Lines.

APPOINTMENTS.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

ASSISTANT EXAMINERS IN THE PATENT OFFICE (20–25). *September 1st.*

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the Secretary,

CIVIL SERVICE COMMISSION,
Burlington Gardens,
London, W.

CONTRACTS OPEN.

HOME.

BOURNEMOUTH.—Corporation invite tenders for the supply of 450 tons tramway rails with fastenings. (Specifications, etc., (deposit £2), Mr. C. W. Hill, Tramways Manager.) August 31.

BOURNEMOUTH.—Corporation invite tenders for the reconstruction of 2½ miles tramways permanent may. (Specifications, etc. (deposit £2), Mr. C. W. Hill, Tramways Manager.) August 31.

CHELMSFORD.—Borough Education Committee invite alternative tenders for (1) supplying and fixing wiring for lighting by electricity; (2) supplying and fixing pipes for lighting by gas, at the Trinity-road Council School. (Particulars from Mr. W. H. Pertwee, architect, The Institute, London-road, Chelmsford.) August 31.

EDINBURGH.—H.M. Office of Public Works.—Electric lighting of Holyrood Palace. Estimate, £6,300.

KIRKCALDY.—Corporation invite tenders for material for one mile of 3 ft. 6 in. gauge single line with four passing places as follows:—No. 1, Permanent way construction; No. 2, Steel poles and brackets for overhead construction; No. 3, Three section pillars with fittings complete; No. 4, Trolly wire and overhead line material. (Nos. 2, 3 and 4, supply and delivery only.) (Specifications, No. 1, Burgh Surveyor, Tolbooth-street; Nos. 2, 3 and 4, Burgh Electrical Engineer, at works.) August 29.

LONDON.—The County Council invite tenders for the wiring and fitting for electric lighting of the second portion of the central car repair depôt, Woolwich-road. Particulars (40s.) from the Clerk of the Council, County Hall, Spring-gardens, S.W. This amount will only be returned if a *bona-fide* tender is submitted. August 30.

LONDON, S.W.—London County Council.—Wiring and fitting second section of Woolwich-road car repair depôt. (Specifications £2, County Hall, Spring-gardens, S.W.) August 22.

MATLOCK.—Urban Council invite tenders for about 1,967 yards patent steel wire tramway cable, with Manilla core (3⅛ in. circumference). (Particulars from Mr. C. P. Foster, Tramway Manager.) August 15.

NEWPORT.—Corporation.—Annual supply of carbon filament electric lamps (British made), radiator lamps (British made), flame arc carbons for Excello and Oliver types of lamps, alternating and direct current two-rate and prepayment meters. (Specifications, 10s., to Borough Treasurer, Borough Electrical Engineer and Tramway Manager.) August 15.

OLDHAM.—Corporation Tramways.—Material and Labour, except electrical equipment, for construction of new tramway in Rippendon-road. (Specifications, £1 1s., Borough Surveyor.) August 17.

RAINHILL.—The Lancashire Asylums Board invite tenders for supply and delivery of telephone apparatus and cable, consisting of main central battery system, metallic circuits and telephone switchboard complete. (Particulars from the Clerk, Rainhill Asylum, Lancs.) August 25.

SALFORD.—Corporation.—Supply of 500 tons steel tramway rails. (Specifications, etc., from Tramways Manager, 32, Blackfriars-street, Salford.) August 15.

SKIPTON.—Urban Council invite tenders for supply of a gas engine and dynamo and necessary wiring for lighting Town Hall. (Particulars from the Surveyor.) August 17.

OVERSEAS.

CAIRO.—Public Works Department.—Electrical installations at Khanka Lunatic Asylum. (Particulars, Service Administratif Ministere des Travaux Publics.) October 20.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope

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THE PROPRIETORS OF THE PATENT No. 23878, of 1900, for "Improvements in Process of and Mechanism for Separation of Conductors from Non-Conductors," are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to HASELTINE, LAKE & COMPANY, Chartered Patent Agents and Consulting Engineers, 7 and 8, Southampton Buildings, Chancery-lane, London, W.C.

THE PROPRIETOR OF THE PATENT NO. 29363 of 1904, for "Improvements in and relating to Electrical Measuring Instruments," is desirous of entering into arrangements by way of license and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to HASELTINE, LAKE & COMPANY, Chartered Patent Agents and Consulting Engineers, 7 and 8, Southampton-buildings, Chancery-lane, London, W.C.

THE PROPRETOR of LETTERS PATENT No. 23491 of 1902 relating to "Magnetic Wheels," desires to dispose of the Patent or to grant licences to interested parties on reasonable terms with a view to the adequate working of the Patent in this country.—Enquiries to be addressed to CRUIKSHANK & FAIRWEATHER, Ltd., International Patent Agency, 65-66, Chancery-lane, London, W.C.

SITUATIONS VACANT.

APPLICATIONS for Appointments effectively arranged, ensuring favourable consideration. Numerous unsolicited testimonials. Expert advice. Write now.—HERBERT GREATOREX, Beechwood, Matlock.

WANTED, Competent Electrical Engineer Draughtsman, thoroughly conversant with Motor Car Construction. Give experience, references and salary required. Box No. 52, c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

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ELECTRICAL GRADUATE of an American University, with 1½ year's practical training with the largest Electrical Company at present in America, desires position with some Technical Institution or in Electrical Laboratory. Can furnish excellent references both in England and America.—Address, Box N.Y., c/o THE ELECTRICAL ENGINEER.

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FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

WIREMAN, 5 years' experience; age 25.—Box T., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, seeks apprenticeship with Electrical Engineer. Intelligent, good education.—S.A., c/o ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

A CAPABLE ELECTRICAL ENGINEER, shortly disengaged, Home and Colonial experience, stationary or erecting. C. I., New Rock Colliery, Stratton-on-Fosse, near Bath.

marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received, up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. (Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels.) September 26.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). (Specifications, Direction des Chemins de Fer d'Outre-mer, Lisbon.) October 12.

LORENZO MARQUES.—Harbour and Railways Board.—One 10-ton and 75-ton electric cranes. (Particulars, 9 milreis gold, General Stores, Harbour and Railway Board, Lorenzo Marques, or Agency of Caminhos de Ferro de Lorenzo Marques, Johannesburg, or Direcçao dos Caminhos de Ferro Ultramarinos, Lisbon.) English translation, 4·5 milreis gold, from Caixa Geral dos Depositos, Lisbon, or from the Johannesburg or Lorenzo Marques authorities above indicated. September 5.

MELBOURNE.—H.M. Trade Commissioner for Australia (Mr. C. Hamilton Wickes) reports that tenders will be received, up to 3 p.m. on September 20, at the office of the Deputy Postmaster-General, Melbourne, for the supply of telegraph and telephone material (Schedule No. 308). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. A copy of the specification, etc., may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

MOSTAR.—Municipality.—Electricity works. (Particulars from Chief Magistrate.) October 1.

THE HAGUE.—Colonial Office.—Tramways in Batavia and railways. Estimate, £120,000.

TRIPOLI (SYRIA).—Municipality.—Electric tramways.

WELLINGTON, NEW ZEALAND.—Tenders will be received by the Minister of Telegraphs, General Post Office, Wellington, New Zealand, up to noon on December 15, for the supply and erection of installations of wireless telegraphy at or near (1) Doubtless Bay, (2) Gisborne, (3) Cape Farewell, (4) Sumner, near Christchurch, and (5) Bluff. A deposit will be required with each tender. Copies of the specifications, conditions, and forms of tender may be obtained on application to the office of the High Commissioner for New Zealand, 13, Victoria-street, London, S.W. Copies may also be obtained by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

WINNIPEG.—Board of Control.—40,000 ft. of 13,000V 3-core cable. (Specifications, Power Engineer, Carnegie Library. Deposit, $100.) September 1.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so:—

BURNLEY: H. Littler, architect, 16, Ribblesdale-place, Preston. Elementary School for 300 children at Hapton.

CHRISTCHURCH: A. Druitt, clerk. Infirmary at Workhouse.

FOLKESTONE: Designs are invited for a Secondary School for 150 boys.

GORLESTON-ON-SEA: D. O. Holme, clerk, Castle Chambers, Norwich. The Governors of the East Anglian Institution for Blind and Deaf Children are inviting designs for a new building.

GREENOCK: Plans have been adopted for additions to the Government Torpedo Works on the Clyde, involving an expenditure of about £25,000.

HALIFAX: T. Kershaw, architect, Lancashire and Yorkshire Bank Chambers. Branch Bank.

KNYPERSLEY: G. Balfour, Director of Education, Stafford. Elementary School for 350 children, and Handicraft Centre.

MACCLESFIELD: Whittaker & Bradborn, architects, 19, King Edward-street, Macclesfield. Elementary Schools.

PONTEFRACT: Garside & Pennington, architects, Roper Gate, Pontefract. Re-building Inns.

STONE: G. Balfour, Director of Education, Stafford. Combined Cookery, Laundry Work, and Handicraft Centre.

SHERINGHAM: The Urban Council propose to put up new Offices.

WORKINGTON: Clark & Moscrop, architects, Darlington. New Technical and Secondary School.

WARRINGTON: J. M. Murray, secretary, Warrington Education Committee, Sankey-street. Public Elementary School.

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MISCELLANEOUS.

CLEANERS and BLEACHERS of Meat Cloths for Engineers' and Garage use, sold in 7 lbs. bundles at 3/6, cash with orders. Carriage forward.—A. & T. INGERSOLL, 62, Waterloo-street, Camberwell, London, S.E.

EVERY ARC LAMP USER in the kingdom should read "The Application of Arc Lamps to Practical Purposes," by Justus Eck, M.I.E.E. The best book on the subject ever issued. Clearly written and well illustrated. Practically it is the "Arc Lamp Users' Manual." Cloth 8vo. 2s. 9d. net, post free, from RENTELL, Publishers, London.

ESTABLISHED FIRM of ELECTRICAL CONTRACTORS in provincial town contemplating opening a branch in Manchester or purchasing small established Electrical Business there, wish to enter into negotiations with a young, energetic man as REPRESENTATIVE. Applicants must have practical experience in the business and, preference would be given to one having a thorough knowledge of estimating and possessing a local connection among Consulting Engineers, Architects, and principal business houses.—Apply, stating age, experience and remuneration required, Box 80, c/o. THE ELECTRICAL ENGINEER, 149, Fleet-street, London, E.C.

PLANT WANTED.

PLATINUM UTENSILS, SCRAP, LAMP TOPS.—Best prices given by DERBY AND CO., LTD., 44, Clerkenwell-Road, London, E.C. N.B.—Platinum Sold.

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Total Funds exceed - £13,000,000
Claims Paid exceed - £70,000,000

Chairman: RT. HON. LORD GEORGE HAMILTON, G.C.S.I.

The Company transacts all the principal classes of Insurance business on advantageous terms, including

FIRE - LIFE - ACCIDENT

Marine, Loss of Profits, following fire, Workmen's Compensation, Fidelity Guarantee, Burglary, etc.; also undertakes the duties of Trustee and Executor.

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The Company has always encouraged the development of Electricity, and the well-known "Phœnix Fire Office" Rules for Electrical Installations are in use throughout the world. Copies will be supplied free on application to the Head Office.

G. H. RYAN, General Manager.

PLANT FOR SALE.

Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

DYNAMO, 150 volts, 400 amps., 900 revs., shunt wound, three bearings, 16 in. pulley; good condition; can be seen at work any time.—WALKER, Rosehill Tannery, Bolton.

BOUND VOLUMES

— OF —

THE ELECTRICAL ENGINEER

Vol. XLV.

JANUARY to JUNE, 1910.

NOW READY. PRICE 8s. 6d.

NOTES.

Locking Nut Crowns.

The British and Colonial Manufacturing Company, Ltd., are placing on the market the Columbia Patent Nut Crowns, a quite simple contrivance, a kind of cap in steel which fits over any screw nut and at once converts it into a "Castle Nut," thus giving perfect safety at little cost and without any trouble. With this little device it is impossible for any nut to work loose, no matter what the jolting or vibration may be. These nut crowns take up practically no room and do not interfere with working parts. They should be brought under the notice of all engineers, and are also worthy the attention of motorists and others.

Electric Lifts.

Messrs. A. W. Penrose & Company, Ltd., of Farringdon-road, London, have secured the contract for the electric lifts required in the new Head Post Office at Edinburgh, the contract amounting in all to about £4,000. This is in addition to the following work which they already have in hand for the Post Office: Three 30 cwt. goods lifts for the new Western District Post Office; 3 alternating current lifts, Sheffield; 1 passenger lift, Leeds; 1 passenger lift, Newcastle-on-Tyne.

Electric Clocks.

Evidently, Mr. Hope-Jones' paper, read before the Institution of Electrical Engineers in February last, has given a fillip to the business of electrical time service. The Synchronome Company inform us that they are installing their system of electrical impulse dials in the following places: Transvaal Government Offices, Pretoria; Transvaal University, Johannesburg; The Royal Courts of Justice, Rangoon; Locomotive Workshops and Model Village for the Manchurian Railway at Shakako; London and South Western Railway, engineer's office, Waterloo; London and South Western Railway, Waterloo South Station and General offices; London and South Western Railway, locomotive and carriage works, Eastleigh; Nestle and Anglo-Swiss Condensed Milk Company, Eastcheap; time ball on dome of Kingsway Hall; The General Accident Assurance Corporation, Aldwych; The Railway Passengers Assurance Company and Union Bank, Eastcheap; The Hospital for Women, Soho-square, W.C.; Y.M.C.A. Headquarters, Manchester; The Isle and Abbey of Caldey, complete time-circuit throughout the Island; The Dundee Technical College, extension of time-circuit; The Synchronome Company are exhibiting at Brussels, and have been honoured with instructions to instal the system in the Royal Palace at Laëcken.

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TECHNICAL CLASSES.

City and Guilds of London Institute.

ENGINEERING AND CHEMISTRY.

There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE.

(EXHIBITION ROAD, S.W.)

A College for higher Technical Instruction for Day Students not under 16 preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a "*School of the University of London*," and also forms the *Engineering Section of the Imperial College of Science and Technology*. The Entrance Examination includes the subjects of Mathematics, Mechanical Drawing, Physics, Chemistry, English Composition, and French or German Translation, and the Courses of Study for the Associateship of the Institute cover a period of three years. Fees, £36 per Session. Professors :—

Civil and Mechanical Engineering .. W. E. DALBY, M.A., B.Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering .. .. T. MATHER, Wh. Sch., F.R.S.
Chemistry .. .. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics .. O. HENRICI, Ph.D., LL.D., F.R.S.

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A College for Day Students preparing to enter Engineering and Chemical Industries, and for those who have already served an appreaticeship, and also for Evening Students. The subjects of the Entrance Examination are Mathematics, and English Composition and Precis Writing. The Day Courses in Mechanical or Electrical Engineering cover a period of two years, and those in Chemistry three years. Fees, £20 per Session. Professors :—

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Mechanical Engineering and Mathematics .. E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry .. .. R. MELDOLA, F.R.S., F.I.C.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C.

University of Durham.

Armstrong College, Newcastle-upon-Tyne.

PRINCIPAL: W. H. HADOW, M.A., D.MUS.

SESSION 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

Departments of Mechanical, Marine, Civil, and Electrical Engineering, Naval Architecture, Mining, Metallurgy, Agriculture, and of Pure Science, Arts, and Letters.
Full particulars may be obtained on application to—

F. H. PRUEN, M.A.,
Secretary.

Armstrong College,
Newcastle-upon-Tyne.

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The work of these Departments is carried on in separate blocks of buildings specially equipped for systematic instruction. Prospectus may be had free on application from the Registrar.

THE NEXT SESSION BEGINS ON OCTOBER 4th, 1910, on which day the ENTRANCE EXAMINATION will be held at 10 a.m. and 2 p.m.

Northampton Polytechnic Institute, Clerkenwell, London, E.C.

ENGINEERING AND TECHNICAL OPTICS.

MECHANICAL AND ELECTRICAL ENGINEERING AND ELECTRO-CHEMISTRY.

Full Day Courses in the Theory and Practice of the above Subjects will commence on MONDAY, OCTOBER 3, 1910. The courses in Mechanical Engineering include specialization in Automobile and Aeronautical Engineering, and those in Electrical Engineering include specialization in Radio-Telegraphy. ENTRANCE EXAMINATION on WEDNESDAY and THURSDAY, SEPTEMBER 28 and 29. These courses include periods spent in Commercial Workshops, and extend over four years. They also prepare for the degree of B.Sc. in Engineering at the University of London. Fees, £15 or £11 per annum.

THREE ENTRANCE SCHOLARSHIPS of the value of £52 each will be offered for competition at the entrance examination in September next.

TECHNICAL OPTICS.

Full and Part Time Day Courses in all branches of this important department of Applied Science given in specially equipped laboratories and lecture rooms.

Full particulars as to fees, dates, etc., and all information respecting the work of the Institute, can be obtained at the Institute, or on application to

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE, GLASGOW.

SESSION 1910-11.

Day Classes begin TUESDAY, September 27. Evening Classes begin Thursday, September 22.

The DIPLOMA of the College is granted in the following departments:—Civil Engineering, Mechanical Engineering, Electrical Engineering, Mining, Naval Architecture, Chemistry, Metallurgy, Mathematics and Physics, Building, Textile Manufacture.

The Courses of Study for the Diploma usually extend over Three Sessions. The average fee per Session is £12 12s. Holders of the Diploma are eligible for the Degree of B.Sc. in Engineering of the University of Glasgow after attendance for at least one Session upon prescribed University Classes. In conjunction with the Glasgow School of Art a Course for a Joint-Diploma in Architecture has been arranged.

The preliminary examination for Candidates for the Diploma begins on September 19. Names of Candidates must be lodged not later than September 1.

New and well-equipped Laboratories have been provided in the Departments of Physics, Chemistry, Technical Chemistry, Dyeing, Metallurgy, Mechanics, Motive Power Engineering, Electrical Engineering, Mining, Textile Manufacture, Biology, Bacteriology and Navigation, and facilities for research are afforded.

Calendar (price by post, 1s. 4d.) and Prospectus (gratis) will be sent on application to the Secretary.

STANDARD ELECTRICAL WORKS.

ADVANCED ELECTRICITY AND MAGNETISM. By ARTHUR W. POYSER, M.A. With 317 Illustrations. Crown 8vo, 4s. 6d. [0133]

ALTERNATING CURRENTS, AN ELEMENTARY TREATISE ON. By W. G. RHODES, M.Sc. (Vict.), Consulting Engineer. With 80 Diagrams. 8vo, 7s. 6d. net. [0143]

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ARITHMETIC OF ELECTRICAL ENGINEERING. For Technical Students and Engineers. Containing 72 Worked Examples and 300 Exercises. With numerous Illustrations. 1s. net; post free, 1s. 3d. [1250]

ARMATURE CONSTRUCTION. By H. M. HOBART, M.I.C.E., &c., and A. G. ELLIS. With 420 Illustrations and Coloured Diagrams. 15s. net. [1258]

THE ELECTRICAL ENGINEER, 149, FLEET STREET, LONDON, E.C.

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CORRESPONDENCE.

All communications intended for the Editor should be addressed "THE EDITOR, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

THE NATIONAL TELEPHONE COMPANY.

Sir,—My attention has been drawn to a statement recently appearing in the Press as a result of a speech by the President of the National Telephone Company at the half-yearly meeting of that Company as to the alleged injustice and hardship which is being caused the shareholders of the National Telephone Company, Ltd., by the action of the Government in terminating the license of the Company and transferring the whole of the telephone monopoly to the direction of the Post Office Department.

As an ex-employé of the National Telephone Company, I desire to encroach upon your valuable space to deal with the facts as they really are, and as are probably only known by the employés and ex-employés of the Company.

As to the alleged hardship, the present prices of the Company's stocks and shares as quoted by this morning's paper, each class of which shows a considerable premium upon the par value, from a financial standpoint, is a sufficient answer to any alleged injustice which it has been suggested will be done, and on turning to the recently published report of the Company it is seen that a 6% dividend has been paid on all classes of shares, and further that the reserve fund of the Company has reached the enormous sum of £3,705,127, which, when it is considered that the total capital of the Company is but £16,000,000, suggests that the possibility of any loss in connection with the sale of the plant has been adequately provided for.

Those who know something of the manner of the formation of the National Telephone Company as a telephone monopoly and the way in which the various local companies were bought out and the huge sums paid them for "good will" and of the other directions in which the capital of the Company has been watered, will be in a position to appreciate the fact that the Company's shareholders instead of fearing a grave loss as a result of the transfer are, on the other hand, in expectation of a considerable appreciation of the value of their holdings which would not have accrued had the Company's license been extended for an indefinite period necessitating the raising of further large amounts of capital to provide for the expansion and replacements of the plant which would have immediately resulted.

As a matter of fact the shareholders are deserving of but little sympathy in connection with this transfer, as the manner in which they have treated the public, and, more especially, the way in which they have made their own staff, to whose exertions and loyalty they owe the present prosperous condition of the Company, feel the whole consequence of the altered financial considerations which are necessitated by the near approach of the termination of their license, renders them rather the subjects for criticism than for sympathy.

It should be understood that as the period for which the Company had a license to conduct the telephone service ends at December.31, 1911, the ordinary preparations which are made by a telephone undertaking for the development of their system to meet the demands of the public for connections must be considerably modified, and whereas in the ordinary course of business the Company would be carrying on their constructional works and be providing for the replacement of the more antiquated of their Exchanges by the modern Central Battery system, they are now closing down all these constructional works and dismissing and placing upon "short time" those of their staff who would have been employed upon these very necessary works.

Proposals have been made by the Postmaster-General which, if accepted by the Company, would have allowed of the uninterrupted carrying on of such works and have allocated to the Company and to the Post Office due proportions of the cost according to the benefit derived by the parties from the new plant erected and the plant replaced, but the shareholders acting through their Board of Directors in pursuit of the "cent per cent" have refused these offers, and have thereby caused extreme hardship to their staff, many of whom are threatened with years of unemployment after having served the Company faithfully for periods of 5, 10 and 20 years, and are also disregarding the public interest which demands that the telephone system should be intelligently expanded to meet the demands upon it as occasion arises.

In 1912 and 1913 it will be found, unless some immediate action is taken, that the spare plant at the disposal of the Post Office Department for new telephone lines will be altogether insufficient to meet the requirements of the trading community if the telephone system continues to expand at the same ratio as during the past five years. In this connection it must be remembered that the time taken to enlarge a telephone Exchange or reconstruct underground or aerial line routes varies from 12 months to two years' according to the size and character of the job.

The position of the staff is particularly hard when it is remembered that the telephone industry is a virtual monopoly and that therefore those men who have spent their lives' service in the telephone undertaking who are thrown into the ranks of the unemployed by the policy of the shareholders of the National Telephone Company are rendered, as far as the United Kingdom is concerned, unskilled workers and thereby help to swell the already over-crowded ranks of the unemployed of this character. A further serious consequence to the country and to the public will result in the fact that when the Postmaster-General is in a position to do the necessary constructional work himself, after 1911, the skilled staff which will be required to take in hand the construction work will have been dispersed and it will be found impossible to gather together a sufficient number of practical men to satisfactorily cope with the arrears of work due to the present policy of the Company.

It may be said that the telephone men discharged by the Company will be employed by the Post Office, but it is obvious that until such time as the Post Office take into their own hands the telephone system of the country, they will not have that work at their disposal upon which the men can be employed. It may be possible, after a period of some 18 months, for these men to be employed by the Department, but at the cost of starvation and broken service during the intervening period.

I think when these things become known to the general public it will appreciate the fact that any sympathy which may be felt in this matter should rather be with the staff than with the shareholders of the Company, who are at the present moment causing untold hardship to their hitherto loyal servants, and what is, of course, more important to the public, seriously crippling the future efficiency of the British telephone system upon which the prosperity of the business community, and, therefore, the country, has become so dependent.

Yours, etc.,

"TELEPHONIST."

London, E.C.
August 9, 1910.

EDUCATIONAL.

ARMSTRONG COLLEGE.

The authorities of the Armstrong College, Newcastle-on-Tyne, have issued two prospectuses, respectively for Day Classes and for Evening and Special Saturday Classes. In the first case there will be two courses throughout the Session, one for second year students attending the Junior Physics Course, and the other for the third year of the Degree Course in Electrical Engineering. In the second case two courses, for Juniors and Seniors, will be given during the Michaelmas and Epiphany Terms, each course consisting of twelve lectures. The fees are moderate. The Laboratory is equipped with D. and A.C. Generators and motor transformers, secondary cells, meters, standard and commercial instruments and photometric appliances, single and three-phase A.C. Complete courses are arranged in electrical and magnetic measurements, dynamo and motor management and testing, Electrical transmission of energy by continuous, single and polyphase currents.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

One of the indications of the returning prosperity of the Northern Counties is the preparations which are being made to deal with the larger volume of traffic which is being confidently anticipated. Such an indication is the recent resolve of the River Wear Commissioners to incur an expenditure of approximately £4,000 in converting two disused coal shoots at the Hudson Dock North, Sunderland, into a coal staith of as modern a construction as possible in order to deal with the larger class of mineral wagon which has come into use within recent years. It is within the probabilities that electricity may be found to be a useful adjunct in this connection, inasmuch as the experiment in reconstruction of the coal staithes at Tyne Dock carried out some time ago by the North-Eastern Railway has proved very satisfactory in operation. The work done in this instance was to instal electrically operated winches for the purpose of overcoming the heavy frictional resistance of the large wagons at starting, some winches of special design being then installed. The efficient performance of these winches should be an encouragement to the Wear Commissioners to adopt similar means.

A Novel Bridge over the Tees.

Although somewhat south of the Tyne, the new transporter bridge in the vicinity of Middlesbrough, the foundation stones of which were laid last week, attracts considerable attention among engineers in this area on account both of the originality of design and the magnitude of the work involved. The Tees transporter bridge is to provide rapid transport between the north and south banks of the river at a point where a fixed bridge would prove both expensive and an obstruction to river traffic. On the north bank, especially, the need for such a bridge has in the past been acutely felt, and the new enterprise, which will cost about £80,000, will be of great benefit to the municipality. For the purpose of hauling the car from end to end of the bridge, electric power is, I understand, to be used.

Colliery Activity.

A favourable tone pervades the colliery industry in this area at the present time. At the annual meeting of the Northumberland Colliery Mechanics' Association, it was confidently predicted that before long there will be a great revival of trade. If this is the case—as it is earnestly hoped is the fact—every dependent industry will benefit proportionately, and especially the electrical engineering industry, which should do well in electric haulage work in connection with the Eight Hours' Act. It is to be hoped that the dissention regarding adjustment of wages, of which a certain amount has been heard within the last few days, will not interfere with the brightness of the prospect. In the meantime it is interesting to note a report in the "Newcastle Chronicle" that an important new seam of coal has been found near Bishop Auckland, in the county of Durham, by Messrs. Atherton & Walker, the owners of Coundon Colliery. Sinking operations have been in progress for the last two-and-a-half years, and at 20 fathoms a rich seam of household coal, underneath which are four other workable seams, have been discovered. In the main seam coal has been found to a thickness of 6 ft., so that the development is of prime importance. Work has already been commenced in the new pit.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The Birmingham Corporation Electric Supply Station in Summer-lane has become one of the regular show places for the city's official guests. Last week, at the conclusion of the sittings of the High Court of the Ancient Order of Foresters, a number of the delegates paid a visit to the station on the invitation of the Electric Supply Committee. Guides were provided by the Department to conduct the visitors round in parties and the keenest interest was displayed in what was to be seen, the delegates having among them many mechanics and others, who by their training were qualified to appreciate the manner in which the station is laid out. What appeared to attract most attention was the wonderful coaling arrangements. The boiler house is equipped with overhead coal bunkers capable of containing 2,000 tons of coal from which the coal passes by gravity into the hoppers of the mechanical stokers. Two gravity bucket chain conveyors are used for feeding the overhead bunkers; the return chain, which passes underneath the boiler house floor and along the ash tunnel in the basement, is utilised for removing the ashes from the boiler ash pits. These conveyors are fed by a third (belt) conveyor, which runs at right angles to them along the bank of the private canal basin. The water for condensing purposes is drawn from the canal by steam and motor driven centrifugal pumps and is returned to the canal through a 30-in. pipe laid under the roadway at a point about a third of a mile distant from the station; four steel cooling towers built by the Worthington Pump Company, have recently been erected to work in conjunction with this system.

New Brake.

Fifty of the Birmingham Corporation tramcars are being fitted up with a new form of brake. At present the brakes used on the cars are the ordinary hand-brake and the Westinghouse magnetic brake. The new brake now to be adopted is the Maley electro-mechanical rail brake, which may be operated by two electrical methods. By this means the large increase of braking force due to magnets is obtained, and the balance of weight left on the wheels is employed for braking purposes in generating current for the magnets. The whole weight of the car is usefully used for braking purposes without physical strain on the driver. The employment of magnets gives an additional retardation to that obtained by the weight of the car only, thus raising the critical speed to more than 30 m p.h. on 1 in 8·4 gradient, greasy rail, without sand. The dead lift obtained by taking the car weight on four shoes does away with any objectionable forward dip when making sharp service or emergency stops.

Electrical Territorials.

The Birmingham Engineer Units of the Southern Army, under the command of Colonel Lister, took a considerable part in the telegraph work of last week's military operations on Salisbury Plain, besides putting in a great deal of instructional work of the ordinary military character. For the first time, the Wireless Company was able to give a demonstration of its special capabilities. The promised equipment had not been received from the War Office, but the deficiency was supplied by an outfit of wireless gear kindly lent by Sir Oliver Lodge, the Honorary Colonel of the Corps. Colonel Lister was able to utilise very effectively some broken ground in the neighbourhood of Tidworth Barracks. The Air-Line Company, under the command of Major Vickers, was able to make a good start with the maintenance line and this ultimately extended over a nine miles circuit round a hill, working efficiently. Instruction was given on this line, faults of erection pointed out, and the way in which to keep the line in order was explained. Captain Matthews' Wireless Company had a successful practice. They succeeded in establishing a station at Shipton Bellinger, which remained in operation several days, sending wireless messages to the camp and receiving replies. Turn and turn about, the men of the Company bivouacked beside the station for a 24 hours' instruction. Subsequently the station was removed further south. The

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messages transmitted were accurate and the whole of the operations in every way satisfactory. The Cable Company, under Captain Bowker, set up communication northwards to Burbage, a distance of nine miles, several miles of which was made permanent by Major Vickers's Airline Company after a connection with the camp had been established.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

The local works are settling down to work again after the holidays. They all report the receipt of many good orders, and the general opinion is, that this time the tide of prosperity in the electrical industry has really begun to flow again. Nearly all the outlying towns are carrying out, or at least considering the carrying out, of extensions to their central station plant, principally to meet increased power demands. In addition to the towns which have already been mentioned in these notes, Stockport must be noted as a district in which some important extensions will shortly be made. Details are not yet available as to the exact nature of the work contemplated.

Local Electrification Schemes.

At the half-yearly meeting of the Great Central Railway Company, held in Manchester, last Friday, the Chairman, Sir Alexander Henderson, caused a mild sensation when dealing with a shareholder's complaint about the very dirty and antiquated rolling stock used on a short local line, at present worked by the company. He made the startling announcement that the directors were really thinking of considering the electrification of the line. The Manchester trams run out the full distance, about 8 miles, and get a good proportion of the business which formerly the railway got. Although the resident population of these outlying towns—Altrincham, Sale, &c.—has increased very considerably during the year, the company's traffic receipts are only £15 better than last year. The excellent results attending the London, Brighton and South Coast electrification, as a means of dealing with tram competition, has decided the Great Central Railway and other local lines to go seriously into the matter. The local lay press has been very busy ever since hatching schemes on its own account, but beyond the Chairman's remarks, no definite particulars are officially forthcoming, and for the report that a huge scheme for the electrification of all the district lines is being considered, there appears to be no other foundation than the common sense of the journalist who wrote it. The thing is quite possible, and would no doubt prove highly successful from the railway's point of view, if not from the trams', but the scheme is too big for consideration in this country all at once; it would involve about 100 miles of track, in short lengths radiating in all directions from Manchester! Here we must go slowly, holding on with both hands to the old way, while timidly stretching out a foot to touch the new, to make sure that it really has substance and is not a thing of air—more often to kick it away contemptuously. Carlyle once said, "Risk and win; without risk all is already lost." This is the principle on which all great success has been built, not on that absurd caution which characterises much that is called "enterprise" here. If the electrification schemes do come to anything practical, it is to be hoped that the companies concerned will remember that for some years now there has been a private single-phase line about three-quarters of a mile in length, in the yard of the British Westinghouse works. This was put down when the single-phase traction system was being developed, and a good deal of the resulting equipment has gone to the Continent, principally Sweden. It is strange that the Continent buys English-made goods, while England buys from the Continent; evidently distance lends enchantment to the stuff.

The Accrington Fire.

The gas people will be shrieking themselves hoarse, pointing the moral. This fire is alleged to have been caused by a short circuit in a lamp flexible, setting the flexible on fire and so setting the drapery in the window alight. Despite the efforts of several people, the blaze travelled round the windows very quickly and soon burnt out the whole place, involving five deaths. It appears on a previous occasion a burning flexible had set some other drapery on fire, but this was quickly put out, and does not appear to have alarmed the firm at all, for they had no fire extinguishers, or emergency exits or other things, which gas users would have had as a matter of course. The danger of electricity is its safety. With gas one can always fall back on the smell, if the installation is not quite in the best condition. If window cards are pinned to the gas pipe, the escaping gas protests against such cruelty and discourages the practice. Not so the gentle, docile 'lectric; it does not resent the intrusion of a pin into its inwards, so long as two vitals are not touched at one and the same time, it suffers long in silence, until the strain becomes too great, and then it collapses all at once. What really caused the lamp flexible to break down in the present instance is not known, but in giving evidence Mr. Gray, the town electrical engineer, stated that in some shops he had found price tickets pinned to the flexibles, while lengths of flexible (which might very probably have previously been damaged by the ticket practice) were allowed to lie on highly inflammable goods. People, especially such highly intelligent people as the Accringtonians appear to be, do not realise that they can misuse such simple things as electric light fittings, because they get no warning in most cases that such misuse is taking place. Gas suppliers print elaborate instructions on the back of their bills, for dealing with an escape of gas, and other nusiances inherent in their illuminant. Suppliers of electricity should point out more clearly what are abuses of electrical fittings as distinct from uses. The use of flexible in shop windows has already been very strongly condemned; perhaps this fire will have the effect of stopping its use in such places altogether. Before the gas people do any more shrieking and moralising, let them ask themselves how many gas shop window fires they have had, and how many they would have if their shop window lighting were abused as electric lighting is often abused in such places.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The North of Scotland Electricity Supply Company have recently wired Charlton House, the residence of Mr. More Gordon. The installation consists of 120 lights, Osram and B.T.H. metal filament lamps being used, of 25 and 50 c.p. and 8 and 16 c.p. carbon filament lamps for the odd lighting. Brazed tubing and Simplex fittings were used throughout. It is probable that a motor will be added later for pumping water in the event of fire. This company have also recently equipped Richards' spinning mill for lighting and it is anticipated that electric drive may be added ere long.

Municipalities and the Supply of Fittings.

In accordance with the resolution passed at the I.M.E.A. Convention, held in Glasgow in June last, some of the larger municipalities in Scotland are now being called upon to consider a circular letter from the Hon. Secretary of the I.M.E.A. with regard to the promotion of a Bill to empower all municipal undertakings to supply fittings and do wiring. Mr. Richardson, the Dundee engineer, spoke strongly in favour of the Association's action at a recent meeting of the Electricity Committee of Dundee Town Council. While not desirous of competing with the contractor he expressed the opinion that the contractor was of little or no use to the supply undertaking so far as canvassing was concerned. In Dundee they found that well over 90% of the extra business obtained was canvassed for by the Department's own men. It was agreed to support the Association's proposal.

Extension at Motherwell.

The orders in connection with the extension to the Motherwell Electricity Works have now been placed. Messrs. Babcock & Wilcox, Ltd., of Renfrew, are the successful offerers for water tube boilers at a figure of £1,900; Balcke & Company, Ltd., of London, have got the cooling tower at £818; Messrs. Callender's Cable & Construction Company, Ltd., will supply the cable at £530;

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and the switchboard extension will be by Messrs. Siemens Brothers Dynamo Works, Ltd., at £305. The Motherwell Electricity Committee have also agreed to accept the offer of Messrs. Chamberlain & Hookham for meters.

Falkirk Plant Extension.

The Falkirk Town Council have now agreed to accept the following offers in connection with the extension to the plant and mains of their electricity supply undertaking, previously referred to in this column:—Zoelly turbine, Messrs. James Howden & Company, Ltd., Glasgow; boilers, Messrs. Lindsay Burnet & Company, of Govan; condensing plant, Messrs. Mirrlees Watson & Company, Ltd., Glasgow; alternator, Messrs. Bruce Peebles & Company, Edinburgh; rotary converters and switch gear, Messrs. British Westinghouse Company, Manchester; cooling tower, Messrs. Balcke & Company, of London; cable, Messrs. Callender's Cable & Construction Company.

Leith Corporation Electricity Department.

The Electricity Department of the Leith Corporation in connection with an extension to their generating station have just placed an order with the British Westinghouse Company, for a turbo generator at a price of £4,775.

Electricity in Schools.

It is worth noticing that in connection with a number of new schools which have been erected in or near Glasgow during the past year, electricity has been preferred for lighting in practically every case. The Cambuslang School Board have just completed a higher grade school which is lit throughout with metal filament lamps, and the Rutherglen School Board in connection with a large new school which they have just had erected, have also adopted electricity as the illuminant. Glasgow contractors have done the work in both cases. School architects are now agreed that for school lighting electricity is the right thing alike on the score of economy, efficiency and the health of the children.

Greenock Electricity Department.

The year's working in the Greenock Electricity Department shows a surplus of £3,250, and is the best yet realised. It has been obtained after the payment of the increased rate of sinking fund, as instructed last year by the Scottish Office.

Smoke Abatement Exhibition.

Fifty exhibitors from all parts of the country have taken space in the forthcoming Smoke Abatement Exhibition, to be held in Glasgow, and among the electrical firms may be mentioned Simplex Conduits Ltd., Drake & Gorham, James Milne & Son, Alexander Lindsay, Haddow & Company, General Electric Company, Malcolm & Allan, and Wm. McGeoch & Company. The gas and electricity consumed in connection with the exhibits is to be supplied free by the Corporation.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The August number of the "A.E.G. Zeitung" contains the conclusion of a discourse on the A.E.G. turbines delivered by Heinrich Treitel at the Gelsenkirchen meeting of the Enischer Verein of German engineers, and also of an article by Dolivo-Dobrowolsky on current-measurement. There is also an article on the N.A.G. boats motor, and a well illustrated article by Theodor Lindner on water power plants. G. Ziem describes the electrical installations of the Vulcan Company, at Stettin, the biggest shipbuilders in Germany. The number also contains an illustrated article on high tension cables at Osaka, in Japan, and concludes with an illustrated article on electrically driven machines for piling logs.

Domestic Electricity.

Ritter, writing in the "E. T. Z." on domestic cooking by electricity, states that 4,100 kg. of coal (quality not stated) are equivalent for cooking purposes to 800 cubic metres of coal gas and 600 kw. hours. If we put the coal price at 33s. per 1,000 kg., the gas price at 133s. per 1,000 cubic metres or 3s. 9d. per thousand (as reckoned in England), and the electrical price at 160s. per 1,000 kw.-hours, we can calculate that gas cooking for a family of four persons costs per annum, with coal, 133s.; with gas, 100s.; and with direct electric heating about 93s. No doubt, where different prices prevail the proportions would be about the same. Nevertheless, full advantage cannot be taken of electricity for cooking purposes unless the present electrical cooking apparatus is much improved. It is at present far behind other electrical contrivances, and as a rule is difficult to manage and wasteful of current.

Water Laws in Germany.

The extension of the use of water power in this country to the generation of electricity is making itself felt in resistance to private water rights all over the country. In Karlsruhe, for example, an attempt to alter the law confining the right to the use of water to private owners should be transferred to the State could no longer be resisted. Hence the Landtag in 1908 passed a temporary law to prevent new exploitations before the question was finally settled. As the present Landtag was unable to come to any decision on the matter it has been agreed to extend the operation of the temporary law until the end of 1912 as a final limit. Thus the permission to utilise the water powers concerned can at present be refused if the proposed undertaking would interfere seriously with existing public and municipal interests.

Alpha Rays from Polonium.

Bergwitz, of Brunswick, has been studying the action of alpha rays on water. Griesel pointed out some time ago that the solution of radium bromide on water was attended with the evolution of considerable quantities of gas, chiefly hydrogen and oxygen, the proportions between the two being according to Ramsay and Soddy 2.6.1, with a bit of helium. There can be no doubt from the conditions of the experiments that the decomposition of the water due to alpha rays, but the method of their action is uncertain. They may break up the water molecules by sheer mechanical action, or they can separate electrons from the molecules, thus ionising and chemically decomposing them. To discover whether or not under the circumstances mentioned the energy of the alpha particles was consumed solely in decomposing the water, Bergwitz repeated the experiments, substituting polonium, a purer and stronger emitter of alpha rays than radium for the latter substance. He found that only about one-tenth of the energy of the alpha rays acted chemically, the remainder being converted into heat.

Nickel in Electric Lights.

The Siemens & Halske A.G., of Berlin, have patented a method for using nickel for increasing the ductility of tungsten in making filaments for electric lights. The nickel is subsequently volatilised by heating the wire.

Company Affairs.

The Vogtländische Bank and the Vogtlandische Elektrizitats gesellschaft between them have started a new company with a capital of 2,000,000 marks, to be called the Deutsche Gluhlampenfabrik A.G. Plauen.

Electrolytic Sulphuric Acid.

Some important researches which seem likely to have practical results in the near future are described by A. Moser and N. Isgarischew in the "Zeitschrift fur Elektrochemie." They refer to electrolytic production of oil of vitriol. It has hitherto been the fate of few important chemical reagents to escape the grip of the electrician, despite the fact that he almost always relies upon chemical action to put the finishing touch, the electrolysis being concerned only with production of the reagents taking part in the final process forming the product desired. The most important of all chemicals, if we except water, sulphuirc acid is now in great risk of being withdrawn from the sphere of the lead chamber, having survived many catalytic proposals based on salts of copper, etc. Coehn & Becher have shown that the ultra-violet rays

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break up sulphur trioxide into sulphur dioxide and oxygen. It was therefore suggested that ozonised air might convert the dioxide into trioxide, and experiments with a view to test the matter have given excellent results. The point is, from a commercial point of view, not that ozone can convert sulphur dioxide into sulphur trioxide, a substance yielding oil of vitriol, on contact with water, but that at the present time the ozonisation of air by the only known method (electrification by the silent discharge) can be done very cheaply. It is true that the conversion of the fumes of burning sulphur into sulphuric acid cannot as yet be effected as cheaply as in the lead chamber with its ponderous bulk and frequent repairing expenses, but there can be little doubt that the electrolytic method, once properly worked out, will hold the field. The saving in space and maintenance expenses alone would condone many faults. There can be little doubt that when the proper proportion between air and sulphur dioxide for the gas to be ozonified have been settled and when details of voltage and current strength are fixed for particular cases, the electrolytic production of sulphuric acid will become of commercial importance in countries where electric current is cheap. It is better to pay a little more for acid in such places and save freight, and it may quite well be that producers of sulphuric acid by electrolysis will soon be able to pay freight to countries where electric power is more expensive. The following table sums up the results of many experiments with a mixture of 61·5% of sulphur dioxide, 32·4% of oxygen, and 6.1% of nitrogen (determined by loss). They were carried out at the moderate temperature of 67° C.:

Current Voltage.	Current strength in milliamperes.	grames of SO_3 formed.	Time taken	grammes of SO_3 per KW hour.
12,500	1·92	·0102	15 min.	3·5
12,650	2·90	·056	27 ,,	7·4
12,650	2·80	·0299	8 ,,	14·3

It is important to have the sulphur dioxide and the oxygen in volume proportions as near as possible to those theoretically required, viz., two-thirds SO_2, and one-third oxygen, before ozonisation is commenced. Excess of oxygen may lead to the formation of an oxide of sulphur having probably the composition expressed by the formula S_2O_9, while deficiency of oxygen, or what is the same thing, excess of sulphur dioxide, may result in a separation of solid sulphur, a clear waste of energy.

Submarine Cable Agreements.

An agreement has recently been made between Germany and France respecting the mutual use of submarine cables belonging to these nations. This marks an important step in the improvement of good relations between the civilised countries in general and, of course, between the two countries chiefly concerned in particular. No details are at present known, except that it is agreed that each nation should help the other as far as possible and avoid as far as possible all cutting of prices. The idea seems to be to make the combined French and German undertakings co-operate under somewhat the same conditions as have been recently adopted by certain English railway companies. It is also in contemplation to make the Franco-German transoceanic telegraphic service still more independent of Great Britain by laying a submarine cable between Emden and Brest.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The comments of one of the English electrical journals on the Edison storage battery, which have been reprinted here, would seem to indicate that the claims of the famous inventor are still regarded by some people with a good deal of cheap scepticism. On this side of the Atlantic Mr. Edison's claims have been very frankly accepted, and if a certain amount of humour (of a sort) was expended at the outset, the actual working of the battery cars has proved such an unqualified triumph that all the doubters have been converted. He was interviewed the other day by a representative of the "Electrical Review" of Chicago, to whom he told many interesting facts in connection with the development of this wonderful battery. At the outset his greatest difficulty was in securing the proper kind of iron, and he said that even when he got the best kind obtainable it had to be prepared in a very special way to ensure uniform performance; and the same conditions applied to the nickel. Catalytic action from traces of impurities also gave him a good deal of trouble. As to the durability of the battery, Mr. Edison had some really surprising things to say. "We have developed a machine," he declared, "which has taken the cells and lifted them and dropped them over one-half inch upon a hard, rigid body 1,000,000 times, without doing any physical damage whatsoever. The containing pockets and pencils are devised and arranged so that they are practically indestructible, and the solution used brings about the desired electrochemical change without attacking either the elements of mechanical construction or deteriorating in any way the active material of which the cell is composed. And the astonishing feature of the battery is its recuperative qualities and its ability to stand heavy discharging, over-charging and absolute short-circuiting. You can overcharge this battery without hurting it a bit; you can discharge it again and again down to a fraction of a volt, and it will come right back. And, more remarkable than this, is the actual growth in capacity of the cell under repeated charging and discharging."

A Railway Battery.

Mr. Edison went on to say that he was at work on several new applications of the battery. "The thing I am most interested in at present," he said, "is the development of a battery for railway purposes, from which we can take a very heavy charge or a long-continued discharge, and put the energy back in a very short time; in fact, I shall soon have a battery that we can put into a locomotive and draw three regular railroad cars for twenty-seven miles at the regular schedule speed, and at the end of the discharge put all of the energy back in thirty minutes. There will be no difference in the material or in the construction, except that where the retaining pencils in the present battery are a little over a quarter of an inch in diameter, they will be much smaller in diameter. By greatly increasing the divisibility of the self-contained elements, the internal resistance will be lowered. By increasing the divisibility of the elements we will bring about a ready facility for accelerating both the charging and discharging of the battery." But his great idea is still that of making it possible for every man to have an electric car of his own. "The idea that we would rid the streets of horses and replace them with electric runabouts and electromotor trucks is what I have been working for, and now I know that this is coming about. They say that the electric vehicle is not a hill-climber, but we have had cars running night and day over the worst kinds of road, through the sand and mud, up hill and down hill, getting a hundred miles on each charge, and still leaving the car with twenty-five or thirty miles in the battery for any emergency. The battery will give an excellent performance on an average of fifteen miles an hour, and if you wish, you can speed it up to twenty-eight miles, if you care to go that fast. The battery is all right, and it is just a question of hitching it up with the right kind of a motor and putting it into the right kind of a car."

Depositing the Nickel.

The battery, as is now pretty well-known, depends upon the oxidation and reduction of nickel and iron in a caustic potash solution. The negative, or iron, plate has a flat pocket-like construction. These pockets are shaped up from nickel-plated, perforated steel bands, the finished pocket being about one-half inch wide by three inches long, with a maximum thickness of a little more than one-eighth of an inch. Each grid contains twenty-four pockets, spaced eight in a row, in three rows. The positive, or nickel, plate consists of two rows of cylindrical rods or pencils, thirty in number, held in a vertical position by the steel support frame. The cylinders are made from a nickel-plated steel perforated band, with a double-lap spiral seam, which restrains the cylinder from any tendency to expansion; and to further prevent distortion

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or expansion, each cylinder is fitted with eight steel ferrules. The difficulty of getting the nickel in thin enough flakes resulted in the evolution of a remarkable scheme of deposition. A machine was built which consists of a series of cylindrical mandrels supported on vertical axles, each cylinder dipping into an electroplating tank. The cylinders, constantly rotating, are plunged into a copper bath and receive a faint blush of copper. They are then withdrawn and carried across on a supporting structure where they are thoroughly washed and then carried further on to a nickel-plating bath wherein they receive a faint blush of nickel. Afterwards they are carried back to the washing bath to be washed, and descend again into the copper-plating solution. In this way a series of 100 platings of copper are interleaved between 100 platings of nickel. The film is then stripped from off the mandrel, and cut into longitudinal sections a little less than a sixteenth of an inch in width. The film, containing 200 separate layers, is about as thick as an ordinary visiting card. After this film has been cut into longitudinal strips, the strips are cut into squares of about one-sixteenth of an inch in cross-section, which are gathered together and placed in a reducing solution. When the metallic copper is removed the nickel flakes separate and are set in drying pans, the moisture is driven off, and metallic nickel is secured in tiny flakes as soft as the finest silk. In filling the positive pencils a series of pencils are stood upright in a holder, into which a series of rams are plunged. From a hopper on either side of the machine a tiny charge of hydrate is fed into each of the pencils and rammed tight, followed by a tiny charge or layer of metallic nickel. This metallic nickel absolutely insures electrical contact between the sides of the perforated metal cylinder and the nickel hydrate, guaranteeing that every portion of the element is in intimate contact with the electrolyte. The flat pocket-like containers for the negative material (the iron oxide) are placed in steel forms with shaped mandrels inserted, and are locked securely in place; the forms are placed in the filling machine, the mandrels withdrawn, and the oxide fed in from a hopper in tiny charges, each charge being driven home by a power rammer. Both the negative and the positive elements are assembled in the supporting grids by hand, making a light-weight, but thoroughly substantial, structure. The plates are then assembled in the nickel-plated steel containing cans, the proper insulating spacers being put in place. The electrolyte is a 21% solution of potassium hydrate, with a small addition of lithium hydrate.

Battery Cars for Railway Service.

The storage battery equipment of a converted horse-car on the New York Third Avenue Railroad has proved so successful that 30 similar equipments have been ordered for service on this line. Twenty-five new car bodies are to be built and five old horse-car bodies are to rebuilt for this purpose in the shops of the Third Avenue Railroad Company. The motor equipments and control will be furnished by the General Electric Company, and the storage batteries will be supplied by the Gould Storage Battery Company. A remarkable feature of the contract with the battery company is an agreement to maintain the accumulators for five years at a fixed price per car-mile. The battery company has agreed to do all necessary cleaning, furnish all renewals of chemicals and water, make repairs, and generally maintain the efficiency of the cells in good operating condition. This contract is said to be the first of the kind ever made. The cars will be 26 ft. 5 in. long over all and 6 ft. 5½ in. wide. The platforms will be about 4½ ft. long and designed for prepayment operation. The car body proper is 18 ft. long and will have longitudinal seats for 24 to 26 passengers. Under the seats on each side, a space 17 ft. long by 12 in. wide by 15 in. deep will be provided for the batteries, and room has been left in front of the battery casings under the seats for piping in case it is decided to use hot-water heaters. In general, the car bodies will be constructed of wood throughout and the interior finished in yellow ash. They will be mounted on single tracks, built up of riveted commercial shapes, each truck pedestal having three vertical springs. The storage battery equipment will consist of 58 cells of the Gould 29-T-H type, having a capacity of 420 ampere-hours when discharged at a 70 ampere rate and at a temperature of not less than 80° Fahr. It is defined in the contract that "battery operating condition" means maintaining the efficiency of the batteries to at least 75% of their rated capacity. The motor equipment per car consists of two G. E. No. 1022 automobile type motors rated 30 ampere capacity at 125 volts. The motors and the trucks will be furnished with ball bearings. With this electrical equipment it will be possible to maintain a regular schedule speed of 7 miles per hour, figuring on eight stops per mile. The total weight of the car body, truck and equipment will be approximately 6 tons. The cars will be operated on practically level streets now served by horse-cars.

The Standardization of Engineers.

The Committee which was recently appointed by the American Society of Civil Engineers to formulate proposals for laws regulating the licensing of engineers, has reported that there is already a significant trend of legislation in this direction and urges the necessity for uniformity throughout the country, especially as to what constitutes a civil engineer, their definition being: "A civil engineer, within the meaning of this act, is one who practices any branch of the profession of engineering other than military. Said profession embraces the design and construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbours, river improvements, lighthouses, irrigation works, water supplies, sanitary systems, and the development, transmission and application of power, and includes all industrial, hydraulic, municipal, structural, electrical, mechanical, mining and other works which require experience and the same technical knowledge as engineering schools of recognised reputation prescribe for graduation."

Surface Wiring.

In the course of an article on the best method of securing small consumers, the Chicago "Electrical Review" observes that many prospective consumers of electricity have been lost by reason of the fact that a great number of householders literally cannot afford the cost of wiring their houses, and others, who could well afford to pay the bill, refuse to do so because they do not care to put their hard-earned money into improvements of a landlord's premises, which they may vacate at the termination af their lease. Ordinary electric wiring represents a capital investment which becomes a total loss to a tenant when he moves from one house to another, and unless the landlord or owner can be induced to bear the whole or a large part of the cost, there are few of these people willing to adopt electricity in the home. "In England there are several concerns which make a specialty of surface wiring, and central stations in that country have been able to secure many new customers by this cheap and effective means. As may be expected, most of the new business obtained in this way has been from the poorer classes, but strange to relate there are many prosperous concerns, such as some of the great English schools, which have adopted surface wiring in changing over to electricity from some other form of illumination. And it must not be supposed that these exposed wiring systems are all unsightly. On the contrary, some of them are even artistic, and furthermore, such skill has been expended in installation that the wiring in many cases is practically invisible and is quite as safe as the usual conduit wiring systems. Of course, the cost of installing surface wiring is much less than for other systems, and, what is perhaps equally as important, the necessity for tearing down plastering, etc., is almost entirely obviated. It is time that manufacturers, contractors and central stations began to realise the tremendous help that exposed systems of wiring will afford them in developing new business, especially in hitherto unwired buildings and in securing orders for the rewiring of premises that were wired years ago when wall switches and sockets were not used to the extent they are to-day."

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ASSOCIATION OF CONSULTING ENGINEERS.

Owing to a certain amount of misunderstanding which has arisen, Mr. A. H. Dykes, Hon. Secretary of the above Association, has issued the following memorandum of the

OBJECTS OF THE ASSOCIATION.

One of the principal objects of the Association is to secure that Municipal and other public works shall be supervised by duly qualified consulting engineers. In order that this may be done, it is necessary to know who is a qualified consulting engineer. There appear to be no means of ascertaining this at the present time. It is hoped that the register of the Association will give this information.

The Association will not be antagonistic to the principle of specialisation, as the intention is to include in the Association all branches of the profession—civil, mechanical, electrical, gas, and possibly others. It is not suggested that every member should possess a knowledge of all branches, or even more than one. Every member will be as free to specialise as he is now. All that is proposed is that every member shall be a properly trained and qualified engineer, and that he shall be acting solely in a professional capacity, that is, as a consulting engineer.

It is not intended to encroach in any way on the authority of the Councils of the leading institutions which deal with the different branches of engineering. In fact, it is hoped that these Councils will support the Association as acting in the interests of those of their members who are consultants.

Although the existing institutions are thoroughly representative of the profession of engineering as a whole, their province is to deal with the science and problems of engineering which are of equal interest to all engineers. The Association does not propose to deal with these matters at all, but only with the professional status and conduct of those engineers who have adopted consulting work as their profession, and who represent a comparatively small percentage of the engineering body as a whole.

The bye laws governing professional conduct issued by the Institution of Civil Engineers, and now adopted also by the Institution of Electrical Engineers, require that the members of these institutions, when acting in a "professional capacity," that is, as consulting engineers, shall conform to certain rules. The above institutions can make no distinction between their members, and are therefore not able to say to which of their members the rules are applicable. As the rules stand, a member can act in one capacity one day and in another the next. There is, or should be, as clear a distinction between the work of a consulting engineer and that of other members of the engineering profession as there is between the work of a barrister and that of a solicitor in the legal profession. The Association of Consulting Engineers has been formed to clearly define the above distinction. If it succeeds, it is believed that it will be acting in the interests of the existing institutions.

The register of the Association will, it is hoped, form a complete list of the qualified consulting engineers to whom the professional conduct rules above referred to will be applicable at all times. This register will be open to inspection by the authorities responsible for spending public money, as well as to anyone else requiring the advice of a consulting engineer.

The rules of the Association, which are now under consideration, will be based on the professional conduct rules of the Institutions of Civil and of Electrical Engineers, to which it is intended to add other rules applicable to consulting engineers only. These rules will be submitted to a general meeting in the autumn. It is hoped that all the leading men in the profession will be willing to give their advice and help, so that nothing may be done that would be detrimental to the interests of the existing institutions or of the public.

At present, membership is confined to those who are Corporate Members of the Institution of Civil Engineers, and also of the Institution representing the particular branch of the profession in which they practice. The Institution of Civil Engineers has taken the lead in establishing examinations for admission, and has in many other ways taken great pains to improve the status of the engineering profession. The Association is not prepared at the present time to accept the responsibility of considering the qualifications of engineers other than those mentioned above, but it will no doubt be able to do so in the future, should it receive the support it desires from all members of the profession. A provisional list of members is now being drawn up. This list will be revised after the constitution and rules of the Association have been settled.

It is hoped that all consulting engineers in sympathy with the objects of the Association will send their names to the Hon. Secretary, Mr. A. H. Dykes, of 1, Victoria-street, Westminster, London, S.W., so that notice may be sent them of the general meeting which will be called in the autumn to consider and decide on the rules and constitution of the Association.

RIO DE JANEIRO TRAMWAY LIGHT AND POWER COMPANY, LIMITED.

In our issue of August 5 we called attention to a concession recently given by the Prefect of Rio de Janeiro to the Brazilian Electric Power Company, and, as we pointed out, the position seemed to be rather an awkward one. As a result of our enquiries, we find it necessary to furnish our readers with an explanation and statement of the real position of the Rio de Janeiro Tramway Light and Power Company, Ltd., in regard to the distribution of electric energy in that city. The city of Rio de Janeiro, the federal capital, is governed by an elected municipal council, and a prefect appointed by the President of the Republic, the council being the legislative body, and the latter the executive head of the Municipality. Certain public services, such as illumination, water supply, sewers, etc., are, however, under the administration of the Federal Government, which alone can give concessions relating to them.

The Société Anonyme du Gaz de Rio de Janeiro, a Belgian Company, of which the Rio de Janeiro Tramway Light and Power Company, Ltd., is the owner, has a concession from the Federal Government under which it has (1) a perpetual right to place canalisations, etc., in the public streets of Rio de Janeiro, for the purpose of supplying electric energy for private illumination, this right being absolutely exclusive until 1915. (2) The exclusive right until 1945 to place canalisations in the streets of Rio de Janeiro for the purpose of supplying electric energy for the public illumination.

The concession referred to has been in force for many years, and the foregoing form was, in November last, with the authority of the National Congress, embodied in a decree of the Government and a contract made pursuant to this decree duly signed by the Government and Société Anonyme du Gaz de Rio de Janeiro.

The service of distribution of electric energy for motive force, and the use of the streets of Rio de Janeiro for this purpose, is under the sole jurisdiction and administration of the Municipality, which alone can give a concession therefor. The Rio de Janeiro Tramway Light and Power Company, Ltd., holds the only concession for this purpose, given by the Municipality. Such concession was given under the authority of the necessary decrees of the Municipal Council and is embodied in a contract duly signed by the Prefect and Company in the terms of such decrees. Under this concession, the Rio de Janeiro Tramway Light and Power Company, Ltd., is authorised until the year 1990 to place canalisations, etc., in the public streets for the supply of motive forces and electric energy generated by a hydraulic installation, the right being exclusive until 1915. In accordance with this concession, the Company referred to has for several years past been supplying electric energy generated at its hydraulic installation of 50,000 h.p. capacity at Lages, to all parts of the city and has for this purpose constructed over 500,000 metres of underground canalisations as well as a vast amount of overhead canalisations.

Immediately upon learning of the granting of this new concession, the Société Anonyme du Gaz de Rio de Janeiro and the Rio de Janeiro Tramway Light and Power Company, Ltd., obtained injunctions from the Federal Government prohibiting all work thereunder, and these injunctions were confirmed by the practically unanimous sentences of the Supreme Federal Tribunal on the appeals taken by the Brazilian Electric Power Company from the decision of the Federal Judge, and are in full force and effect. The Brazilian Electric Power Company has not been allowed even to commence any work for the realisation of this illegal act of the Prefect.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

CARMARTHEN.—The lighting of the public streets by the Carmarthen Electric Light Company, Ltd., was inaugurated last week, and is giving complete satisfaction.

CREWE.—Considerable building developments are taking place here, and it is probable that this will lead to extensive calls on the municipal electricity undertaking. Mr. H. H. Denton, the electrical engineer, has prepared an estimate of the probable cost of laying a suitable cable to supply the 40 proposed villas to be erected by Messrs. Clews, Brown & Company, at Wistaston, also to give a supply if required to Berkeley Towers and the Manor House; and that the approximate amount of the same, including stone-ware conduits, cables, boxes, laying, etc., was £500. This will be carried out if half the capital outlay is paid by the contractors or consumers. The Engineer-in-Chief of the General Post Office having stated the maximum current that would be required at the new sorting office, Mr. Denton's estimate of the cost of laying a suitable cable on the draw-in system was £275. According to Mr. H. Beswick, architect to the Cheshire County Council, the supply of electricity to the new County Training College and Hostel would be required for about 360 lights. The Electrical Engineer also stated that the estimated cost of extending the necessary cable from Weston-lane to the Training College was about £500. Then the Town Clerk and Electrical Engineer are to interview Lord Crewe's agent (Mr. W. McCracken) with reference to the development of the land adjoining the site of the County Training College, and the probable requirement of a supply of electricity.

DEEPCAR.—J. Grayson Lowood & Company, Ltd., are about to replace steam by electric pumping at their local gannister mine.

DUBLIN.—The Guardians of the South Dublin Union have accepted the tender of Messrs. Roger Greene & Son, solicitors, of 11, Wellington-quay, Dublin, for a loan of £3,000 for the purpose of the erection of plant to supply the workhouse and its hospital with electricity.

DUBLIN.—The draft report on the Corporation Electricity Department's business for the past year is excellent. Although possessing the sanction of the Local Government Board for various extensions, the Electricity Committee are endeavouring to keep down capital expenditure. With this in view, the City Electrical Engineer proposes an arrangement by which a portion of the South Circular-road work can be postponed; the work which he proposes to carry out being estimated to cost £5,500 instead of the amount of the extensions, £11,200, which the Committee had previously arranged for with the approval of Council. Of the £5,500 a sum of £2,200 approximately was required for the extension of the high-pressure cables from Whitworth Bridge, Usher's quay, to the Parkgate-street substation, with an addition of £950 for the extension of the substation, or a total of £3,150. This portion of the work being urgently necessary in order that the duplicate arrangement for the North Circular-road work should be completed before next winter, the Committee authorised the City Electrical Engineer to arrange with the cable contractors to proceed with the work. As soon as the Board of the South Dublin Union proceed with the work of wiring their premises for electric light, the cables will be extended to the area around the Union premises, the cost being £2,350.

DUNDEE.—Local electrical contractors sent a deputation to the Town Council and succeeded in having the resolution that the Electricity Department should seek powers from Parliament for the supply or hire of fittings and appliance, referred back for further consideration.

GREENOCK.—The Corporation Electricity Department made a net profit of £3,247 during the past year. Of this £1,000 is placed to reserve and the balance will go in aid of rates.

ILFORD.—The Council's Electricity Department made a gross profit of £12,866 during the past year (an increase of £2,187), while the net surplus was £1,569, as against £1 for the previous year. The total cost per unit sold has been reduced from 1·11d. to 1·03d.

INGLESTON.—The new board of the Ingleston Electric Light & Power Company, Ltd., consists of Messrs. W. M. Harris, A.M.I.C.E., John Rowlands, of (Messrs. Walker Dean & Company, Manchester), Thomas Howard (chartered accountant, of Bradford and Leeds), H. Cragg (Ingleton), and C. Bentham (Ingleton). Mr. D. Tattersall is the Secretary.

LEICESTER.—A Local Government Board Inquiry has been held into an application for powers to borrow £19,190 for extensions at the electricity works. It was explained that additional plant was required, chiefly for the supply of current for power. At present the station has four engines installed, one for 1,000 kilowatts, and three for 500 kilowatts. From September, 1908, to the end of the year, 63,192 units were supplied for power purposes from the station; in 1909, 434,262 units were supplied; in the half-year ended June last, 609,285 units were supplied, and the engineer's estimate for the whole of the present year was that a total of one and a quarter million units would be required. In view of the constantly increasing demand, the proposed extension was considered to be the minimum the Corporation could safely ask for. The engineer was of opinion that the extension would meet demands for the ensuing 18 months or two years.

LEITH.—A turbo-generator is shortly to be installed at the Leith electricity station in order to meet the increasing demand for electricity. It is intended to utilise the new plant for tramway and general electricity supply. The machine is to be chiefly run with the exhaust steam from the existing reciprocating engines. The water for condensing purposes will be cooled in patent cooling towers. The Electric Lighting Committee of Leith Town Council have accepted the tender of £4.775 of the British Westinghouse Company, Manchester, for the new plant.

SEVENOAKS.—The Urban Council are applying for a Provisional Order under the Electricity Lighting Acts.

SOUTHAMPTON.—At the suggestion of Mr. H. F. Street, Borough Electrical Engineer, it has been decided that when extensions of mains are made through roads at present lit by gas lamps, it is to be an understood thing that the gas lamps in question shall be changed over to electricity without special application to the Works Committee. This will save time, and it is pointed out that in most cases the revenue obtained by the public lighting would cover the interest on Sinking Fund charges on the main.

STROOD.—As a result of the promoters not having exercised their rights, the Board of Trade has revoked the Strood and Darford (Rural Districts) Electric Lighting Order, 1903, as confirmed by an Act of Parliament passed in the same year. The revocation, which takes effect from July 18, applies to the whole of the proposed area of supply.

TORQUAY.—The Corporation have applied to the Local Government Board for powers to raise £3,500 for cables for extension to Paington and elsewhere. After discussion the amount was raised to £4,500 with the idea of providing sufficient for eighteen months or two years.

WIGAN.—The foundation stone of the Corporation electricity station extension was formally laid last week.

WREXHAM.—Mr. W. G. Pickvance, the borough electrical engineer, has advised his Committee to apply to the Local Government Board for powers to raise a loan of £3,345. This is to make good over-expenditure on work approved £456, expenditure on work not passed by the Local Government Board and other items £989, and for new extensions £1,900. This last is made up as follows:—Fitting out and supplying of machinery tools for repairs to machinery, £250; the installation of a coal elevator combined with measuring machine, £300; automatic expansion gear for No. 3 engine, £250; switchboards, £600; public lighting, £500. The electrical undertaking is very popular, and the Council's decision to adopt Mr. Pickvance's proposal meets with general approval.

OVERSEAS.

BUENOS AIRES.—The Postmaster-General is studying the question of introducing wireless telegraphy throughout the country. He is of the opinion that this system will be much cheaper than land lines. The basis of the project is a State monopoly of all wireless telegraphy in the country. It is locally argued that in some parts the system might work out cheaper than land lines, but that when it comes to the efficiency and speed in working, then the land lines are far and away ahead of wireless.

SANTIAGO.—A concession has been granted to the Santiago River Power Company (Sociedad Anonima), represented by Manuel R. Uruchurto, for the utilisation of water from the River Lermo or Santiago, Tequila canton, State of Jalisco, to a maximum extent of 35,520 litres per second, for generating motive power.

TRACTION.

HOME.

MANCHESTER.—Urged into activity by the enterprise of the Corporation Tramways Department, the railways serving Manchester and district are contemplating acceleration of local service by means of electric trains of one sort or another. The London and North Western, for instance, will shortly place

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motor trains on the line between Manchester and Wilmslow, and if this proves a success, the innovation will be extended to the whole of the branch lines. Other companies are seriously considering some similar moves.

OVERSEAS.

BARCELONA.—Application has been made by the Sociedad Anonima Los Tranvias de Barcelona for a concession for the construction and working in Barcelona of electric tramways. One line, of metre gauge, would run from Marqués del Duero-street by way of Tamarit and Lérida-streets to the Plaza de Murcia; and the other, of a gauge of 1·43 metre, from Marqués del Duero-street by way of Lérida-street to meet the former line at the corner of Tamarit-street.

COMPANIES' MEETINGS AND REPORTS.

BLACKPOOL AND FLEETWOOD TRAMROAD.

The report of the Blackpool and Fleetwood Tramroad Company for the half-year ended June 30 last, to be submitted to the meeting on 25th instant, states that, including the sum brought forward, the balance of profit, after providing for Debenture interest, is £5,277, and the directors recommend a dividend at the rate of 4% per annum, which will absorb £3,000, writing off a sum of £750 to depreciation reserve and £500 to general reserve account, leaving a balance of £1,027 to be carried forward. The number of passengers carried during the half-year was 997,574. The receipts from all sources amounted to £11,997.

CONSOLIDATED ELECTRICAL.

Mr. Herbert Allen presided at the ordinary general meeting, and in moving the adoption of the report and accounts, said they were so explicit that there was nothing required from him by way of elucidation. They had made some slight alterations in dealing with certain items, but these were fully explained in the report. In answer to questions as to the suggested winding up of the company, the chairman said it was not an easy task to satisfactorily wind up the company to the best advantage of the shareholders, and he thought the directors were the best judges to deal with that matter. The report and balance sheet were adopted.

DUBLIN TRAMWAYS.

Mr. Wm. M. Murphy (chairman) presided at the 28th ordinary half-yearly meeting of the Dublin United Tramways Company (Ltd.).

The statement as to the working of the company during the period proved exceptionally satisfactory. The gross receipts, which amounted to £144,916, made a record for the spring half-year, exceeding even the corresponding half of the Exhibition year by £2,555. There was an increase of 5,171 in the car miles run during the half-year.

During the year £4,028 was expended on relaying Westmoreland-street, Nassau-street and Leinster-street, and part of the line in Kingstown, and the relaying of the Dalkey line is now being proceeded with.

Dividends of 6% were ordered to be paid on both the Preference and Ordinary shares, setting aside a sum of £4,000 towards the renewal of cars, including six new vehicles for the Dalkey line.

The shareholders are offered, at £11 10s. per share, the additional capital which it is proposed to raise.

The directors' report stated that the amount available for division was £45,191 4s. 8d., out of which it was recommended that dividends be paid for the half-year at the rate of 6% per annum on both the Preference and Ordinary shares; and that a sum of £4,000 be set aside towards the renewal of cars. The dividends and the sum set aside would absorb £37,900, leaving £7,291 4s. 8d. to be carried forward to next account.

COMPANIES REGISTERED.

JOHNSON BILLINGTON ELECTRICITY METERS.—£8,000, in £1 shares.

LOCH LEVEN ELECTRICITY SUPPLY COMPANY.—Capital, £10,000, in £10 shares. Objects: To take over so much of the undertaking of the Loch Leven Water and Electric Power Company as relates to the supply and distribution of electrical energy (other than the supply to the factories and works of the British Aluminium Company, Ltd.), with the electric lines and other works used in connection therewith, to acquire supplies of electrical energy in bulk from the Loch Leven Water and Electric Power Company or the British Aluminium Company, Ltd., or its successors or others, for the purpose of distributing the same, and to carry on at Kinlochleven and elsewhere in the counties of Inverness and Argyll the business of an electric light and power company. Private company. Table A mainly applies.

In the "Investors' Guardian's" usual half-yearly return of company registrations, we find it recorded that from January to June only £1,522,507 was invested in electrical undertakings, which compares with £2,016,320 for the same period last year, a rather heavy drop, but certainly an improvement on the £853,576 for the first half of 1908. Our contemporary says that this shows the electric enterprises to be still very depressed. It should, however, be remembered that a heavy percentage of money invested in electrical undertakings does not appear in this record, as it is represented by municipal loans raised under authority of the Local Government Board, while there have also been some notable additions to the capital of companies for electrical traction purposes, additional capital which does not go to swell the grand total given above. Unmistakeable signs there are of a steady revival in electricity, and for this we may well be thankful; there are not the unhealthy features of a rubber or oil boom about it, which after all only benefit promoters and the Stock Exchange.

REVIEWS.

"Electric Trains," by H. M. Hobart, M.Inst.C.E. (London and New York: Harper & Brothers. Price, 6s. net.)

Mr. Hobart, already well known as the author of several standard works on electrical engineering and appliances, has now issued another volume which will be of direct practical service to those to whom it appeals. Wisely, he has confined it to electric trains for city and suburban service (a subject which he has made peculiarly his own), purposely excluding the large subject of electric locomotives, and, incidentally, matters relating to details of the design of trucks and car bodies. But he makes references to other publications in which useful descriptive matter may be found, and thus he has been enabled to present within reasonable compass a coherent and compact treatment of his subject such as we venture to think could not otherwise be secured in any one book.

"The Theory of Ionization of Gases by Collision." By Professor J. S. Townsend, F.R.S. (London: Constable & Company, Ltd., Price 3s. 6d. net.)

Ionization of gases by collision is a phase of science whose importance is only just beginning to be dimly understood in electrical engineering. Extensive as have been the experiments, there has hitherto been no collective statement of the theory and the facts upon which that theory is based. There was, therefore, a real demand for a book such as this, which is a valuable contribution to scientific literature. The author divides his subject into consideration of "Ionization by Negative Ions," "Ionization by Positive Ions," "Sparking Potential in a Uniform Electric Field," and the "Theory of Electric Discharges in the Fields of Force which are not Uniform." Certain aspects of the problems raised in this very interesting book are dealt with in our leader columns.

"The Practical Telephone Handbook and Guide to the Telephone Exchange." By J. Poole, A.M.I.E.E. (London: Whittaker & Company. Price 6s. net.)

Little remains to be said of so well-known a book. But we must congratulate both author and publishers on the appearance of this fourth edition, which has been carefully revised. Among the new features are chapters on: Submarine Telephone Cables, The British Insulated Company's Telephone Work and Later Post Office Practice, Development Studies, and Wireless Telephony. So rapidly do matters advance in this connection that a postscript is already required to this last-named chapter, in order to take in the Helsby Wireless telephonic system. So far as it is possible, however, the book places before the reader a thoroughly up-to-date review of present-day practice.

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" Illumination and Photometry." By W. E. Wickenden, B.S. (London: The Hill Publishing Company. Price 8s. 6d. net.)

A careful study of an important, and hitherto rather neglected branch of science. Mr. Wickenden goes deeply into the whole question of production and propagation of light and the broad principles of photometry before discussing gas and electricity in particular. There are two chapters dealing respectively with incandescent electric lamps and the electric arc and vacuum tubes. As a preliminary to the consideration of interior and exterior lighting problems, the author discusses the right methods of practical calculation and plotting data. In an appendix are an exceedingly valuable collection of tables and charts for facilitating photometric and illumination computations, and the preparation of estimates and plans for illumination installations. The book contains a number of illustrations and diagrams.

" Electrical Distributing Networks and Transmission Lines." By Alfred Hay, D.Sc., M.I.E.E. (London: Cassell & Company. Price 10s. 6d. net.)

In the abundant literature of electricity there is certainly a dearth on this very vital aspect of engineering work. The author has been well advised in bringing together a mass of information on the theory and practice of distribution system in so accessible a form. While covering the whole subject, from consideration of general principles to a discussion of the merits of underground and overhead systems, insulation, protection, capacity and inductance of cables, to the localisation of faults and repairing; he has done this with commendable conciseness and simplicity of treatment. It is eminently a book for the student and the busy practitioner.

ENERGY RELATIONS OF DETECTORS IN WIRELESS TELEGRAPHY.

By Dr. W. H. Eccles.

In a paper read before the Physical Society of London, Dr. Eccles gave a record of the results of an experimental examination into the physical properties of the electrolytic detector, the zincite rectifier, the carborundum rectifier, and a thermoelectric detector consisting of a light contact between graphite and galena. The conditions of the experiments have been generally identical with those arising in the ordinary employment of the detectors, and, in particular, the quantities of energy given to the instruments, in the form of electrical oscillations, have been of the same order in these experiments as in actual practice. Three ways of investigation are followed. The first way consists in applying to the detector an electromotive force which is gradually increased, and measuring the current at each step. The second way is to fix the electromotive force at some particular value, to send trains of oscillations of various energy values through the instrument, and to measure the intensity of the sound produced in the telephone on each occasion. The third way is to send trains of constant energy value through the instrument while the steady electromotive applied to it is varied, and to measure at each step the intensity of the sound produced in the telephone. These modes of investigation give curves that may be called respectively the steady current curve, the power curve, and the sensitiveness curve. The chief fact brought to light is that the power curves of all the detectors are straight lines, which suggests that all the detectors are fundamentally thermal in their action.

ELECTRIC LIGHT AND MUNICIPAL TRADING.

At a recent meeting of the Wimbledon Town Council Electric Lighting Committee, the minutes showed that it was resolved to contribute with other boroughs to the cost of promoting a Bill (such contribution not to exceed £25) dealing with the following matters:—(1) The giving of power to all undertakers, being Local Authorities, to provide, let for hire, and fix, repair and remove, but not manufacture, lamps, meters, electric lines, fuses, switches, fittings, lamp-holders, motors, and other fittings for lighting and motor power, and for all other purposes for which electrical energy can or may be used, and provide all materials and work necessary or proper in that behalf, and with respect thereto, demand and take such remuneration for rents and charges, and make such other terms and rents as may be agreed upon. (2) For removing doubts as to the construction to be placed upon clause 15 of the Electric Lighting Act of 1909, dealing with the question of a stand-by supply, a clause would be inserted in the new Bill relieving undertakers from obligation to supply electricity for lighting or power to any premises having a separate supply, electrical or otherwise. (3) The protection of authorised undertakers from the operation of unauthorised undertakers within their area, whose business is not " primarily the supply of electrical energy to consumers."

Councillor Stuart moved the adoption of the minute and Councillor Abbott seconded.

Councillor Williams moved that the minute be deleted. The first clause, he said, was simply introducing a little more municipal trading by getting power to supply fittings, etc.

Councillor Marston seconded.

Councillor Abbott said he was strongly opposed to municipal trading, but he thought they were powerless in this matter. They had invested a large amount of money in their undertaking, and when the consumption was not increasing in the same ratio as the expenditure they must take advantage of such little things as these.

The amendment was defeated by eight votes to five, and the minute was then agreed to.

PUBLICATIONS.

" Minutes of Proceedings of the Engineering Association of New South Wales." Vol. XXIV.

An interesting description of the Westport Stockton Coal Mine, New Zealand, by Mr. C. J. Holroyde, bears witness to the very extensive place given to electricity in the working of mines in Australasia.

" Cable-Fault Localisation Graphs in Practice." By E. Raymond-Barker, M.I.E.E. (London: Alabaster, Gatehouse & Company. Price, paper covers, 1s. 6d.; cloth 2s.)

A reprint of a useful series of articles which have appeared in the columns of *The Electrical Review*, and certainly well worth issuing in collected form.

" Supplement to the Third Edition of The Law of Building, Engineering, and Ship Building Contracts." By A. A. Hudson. (London: Sweet & Maxwell. Price 3s. 6d. net.)

Reports of four important cases. In Patman and Fotheringham *v.* Pilditch, it was held that if a contractor undertakes to carry out a contract for a " lump sum," any work necessary to complete but not specified in the bills of quantities, may be charged for. In Kennedy *v.* Barrow in Furness Corporation, elucidates arbitration clauses and their effects. In Blackwell & Company *v.* Derby Corporation it was held that if an engineer or architect, acting as arbitrator under the contract, should give proof of acting unreasonably, the Court can give relief enabling a plaintiff to pass over the arbitrator and appeal direct to the Courts. In Pearson *v.* Dublin Corporation it was held that a contractor, in spite of disclaimer clauses, was responsible for the consequences of false information fraudulently supplied by their engineer.

PATENTS.

Electrical Heating Device.

6777.—1909. C. F. Parkinson, Walkerville, Paisley, N.B. The primary coils of the transformer are supplied with energy from a source of alternating current, the secondary coil has terminals which support the shelves of the oven or the utensil to be heated. The utensil completes the circuit of the secondary conductor.

Automatic Electric Regulators.

15889.—1909. H. Lutner, Woking. The regulation effected by utilising the potential of the whole or of different portions of the resistance progressively inserted in the lamp circuit or the voltage of any or all of the regulating cells progressively switched out of circuit to energise one or more electro-magnets which attract armatures designed to short circuit in their off position resistances in the field circuit of the dynamo.

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Automatic Windings of Dynamo Electric Machines.

17254.—1909. A. GREENWOOD & T. CHAPMAN, Leeds. The ends of the conductors of windings of the short-circuited type are turned and secured to the short circuiting member with their broad sides towards it by means of screws, bolts or rivets.

Electrodes for Arc Lamps.

18965.—1909. BRITISH THOMSON-HOUSTON COMPANY, LTD., London. The titanium carbide electrode contains a small percentage of free sulphur, preferably about 4½%, although a little more or less may be used. This addition diminishes the spitting of the electrode, while the particles still thrown off and projected against the inside of the globe do not adhere but roll to the bottom and escape when the lamp is opened.

Wall Sockets for Electric Couplings.

19045.—1909. J. M. CONNARE, Watford. This wall socket is so fitted that it does not project beyond the level surface of the wall. It is covered by a pivoted flat plate, which may be coloured the same as the wall to escape notice.

Ship Propulsion.

19871.—1909. BRITISH THOMSON-HOUSTON COMPANY, LTD., London, E.C. A prime mover drives an electric generator which supplies current to a motor mounted on the propeller shaft. Motive fluid is admitted to the prime mover so as to drive it and the generator in either direction. The circuit connections between the generator and motor remain unchanged no matter in which direction the motor is to be rotated.

Elastic Electro-magnetic Power Transmitting Device.

20286.—1909. W. DMITRIEW, St. Petersburg. In this device, which is of the type in which a magnetic system is directly coupled to the driving cylinder while the rotor is cinematically connected to the working machine, a two, four, or 2 n-pole wound asynchronous polyphase rotor conductor is employed in conjunction with a two, four, or any 2 n-poled magnetic system.

Flexible Electrical Brushes.

21180.—1909. R. H. BARBOUR, Crawley Down. The brush comprises a fine wire core, which may be silver plated, stranded into a cord, and a covering of wire wound round each core. The cover does not seriously diminish the flexibility of the brush, but serves as a protection. Moreover, as the covering has a scrubbing effect on the collector rings, it enables the current to be collected with a less electrical loss than when the wire is plainly stranded.

Supporting Current Rails of Railways and Tramways.

21526.—1909. A. WATKINS, Chelsea. The insulator has a central passage for receiving a wooden block which forms a cushion for the rail. The rail is fixed to the insulator by two clamps, which partly encircle the upper portion of the insulator. The insulator is fixed to the sleeper by means of a metal ring which surrounds the base of the insulator. The ring is tightly gripped to the sleeper by hooked plates or clamps.

Electrical Switches.

24373.—1909. N. COLLINS, Aston Manor. The invention consists in the employment in conjunction with the switch contact arm of one or more free balls located within holes in a bracket. The balls are brought by operation of the switch handle into engagement with recesses in the contact arm, so as to lock it in its on or off position until the handle is moved sufficiently for the balls to be released and disengaged from the contact arm, which is then caused by its spring to quickly make or break the circuit.

Electro Deposition Apparatus.

24735.—1909. A. F. HARRIS, Walsall. Cathode studs are employed, which project into the interior of the barrel and are electrically connected to the commutator by means of a metal ring. While the cathodes do not interfere in any way with the articles to be plated, they afford a perfect contact.

Conduits for Electric Wiring Systems.

25577.—1909. A. E. WOODHOUSE, Kingsway. The casing comprises a separate trough and cover built up of superposed notched strips so that it may be bent by hand in any direction and to varying extents to assume a smooth curvature devoid of abrupt angles.

Electric Motor Control.

28941.—1909. BRITISH THOMSON-HOUSTON COMPANY, LTD., London. This is an improved method of operating a number of electric motors which are mechanically connected to drive a common load. The motors are connected in a number of groups. A source of independent voltage is provided for the several groups, and a controlling switch is adapted to connect the groups to the source. In moving to a subsequent position, the connections of one group are varied to increase its impressed voltage while the connections of a second group are maintained.

Electric Meters.

30142.—1909. BRITISH THOMSON-HOUSTON COMPANY, LTD., London, E.C. In meters of the type in which the movable element is immersed in a liquid such as mercury, a sealing device is provided which is constructed with a number of segmental gripping jaws which form part of a thin disc. The jaws are secured to springy arms attached to a rigid ring. The sealing is effected by means of a ring which when moved in a longitudinal direction causes the jaws to move in a radial direction into contact with the meter spindle.

Removing Grease from Objects to be Galvanised.

30463.—1909. H. W. T. SCHULTE, Bielefeld. The apparatus comprises a tank for the electrolytic bath, a central partition and a drum at the lower end of the partition. The drum is composed of bars from which the objects to be degreased are suspended. The drum passes between the two electrodes and beneath the partition.

Electric Circuit Closers.

4318.—1910. H. C. THOMSON, Boston, U.S.A. A distortible member is secured on a base block in its assembled relation by a longitudinal movable plunger, and is adapted to receive a distortion in consequence of the movement of the plunger, which renders the distortible member operative as an electric connection between the circuit terminals.

Multiple Switch Device.

5261.—1910. CUTLER HAMMER MANUFACTURING COMPANY, Wisconsin, U.S.A. Each switch has a corresponding latch which is designed to hold the switch in closed position when necessary. As each switch is closed, it holds the latch of a preceding switch in retaining position. This ensures retention of the switches in a definite sequence. The latches and switches are released singly.

Electrolytic Apparatus with Liquid Annular Anode.

6596.—1910. SCHOTT & GEN, Jena. The restraining body of the apparatus projects upwardly as a protecting wall above the surface of the anode. When the anode particles are thrown up by strong shocks, they are prevented from falling into the central outlet of the anode vessel.

Electric Heating Apparatus.

7860.—1910. BRITISH THOMSON-HOUSTON COMPANY, LTD., London. The heater comprises a number of coils supported at their ends in the usual manner and connected so as to operate together. Intermediate non-insulating supports are also provided for the coils.

Control of Electric Motors.

10307.—1910. ALLGEMEINE ELECTRICITATS GESELLSCHAFT, Berlin. A locking device is provided which engages with an auxiliary control switch. When the speed of the motor is increased beyond its normal full speed, the locking device releases the auxiliary switch and weakens the field.

Electric Switches.

12522.—1910. H. R. SCHULTZ, Trafford Park, Lancs. The casing of the switch is attached to the terminal box of the circuit to be controlled by means of horizontal guide rods fixed to the casing. The guides slide within tubes mounted on the terminal box. The switch contacts are connected to the circuit conductors by means of plugs and sockets attached to the switch contacts and the circuit conductors when the casing is moved into engagement with the terterminal box.

Distribution of Alternating Electric Current.

7121.—1909. A. F. BERRY, Ealing. This is an improvement in apparatus for distributing alternating electric current in which a static transformer is arranged to be put into or out of effective use according to the load on the lamp. The winding constituting the impedance in the primary circuit, and in series with the primary winding of the transformer is provided with a magnetic core that forms a complete magnetic circuit around it so as to increase its choking effect and power factor.

Generation, Transmission and Distribution of Electric Energy.

12685.—1909. M. B. FIELD, Hollinwood. In order to avoid shock to the system on the occurrence of a short circuit or overload, the cables, transformer, or other apparatus are provided with a resistance inductance or capacity of relatively high equivalent resistance value, which limits the possible leakage current and prevents sufficient current passing to operate the circuit breakers by means of their overloads or reverse power attachments.

Electric Induction Furnaces.

14937.—1909. C. GRUNWALD, Bredeney. The ends of the auxiliary winding are attached at two points of a portion of the primary winding which occupies such a position that the electro-dynamic actions which arise between it and the melting bath when the furnace is being worked are without any noticeable influence upon the equilibrium of the melting bath.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year.						Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Car mile.	Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Aug. 4	1,680	1,602	+ 77	— 76	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940.	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	July 31	1,147	1,073	+ 74	+ 396	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	July 30	6,662	6,446	+ 216	—	56·792	56·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,273	— 173	— 1,036	24·53	23·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·24	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	July 30	5,181	4,708	+ 473	+ 3,042	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Aug. 8	2,248	2,060	+ 188	— 52	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Aug. 5	8,254	7,764	+ 490	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Aug. 6	1,303	1,383	— 80	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Aug. 7	318	331	— 13	— 46	6½	6½	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	July 30	5,293	5,216	+ 77	+ 1,089	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6 822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Aug. 7	3,148	2,989	+ 159	+ 94	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Aug. 4	535	586	— 51	+ 1,649	9·89	9·89	Dec. 31	24,044	5,737,476	896,945	—	6·43	—	4·43
Croydon Corporation	July 22	1,680	1,570	+ 110	+ 2,994	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,664	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	314,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Aug. 5	211	214	— 3	+ 24	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Aug. 5	6,530	6,997	— 467	+ 384	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Aug. 6	1,234	1,132	+ 102	+ 388	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	July 30	14,707	14,695	+ 12	+ 9,564	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·86
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·48
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Aug. 6	2,928	2,845	+ 82	+ 3,014	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Aug. 5	164	164	—	— 114	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 6	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Aug. 3	1,572	1,427	+ 145	— 215	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	July 31	1,517	1,432	+ 65	— 11	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	July 27	41,445	36,098	+ 5,347	+ 98,399	133	118½	Mar. 31	1,274,660	279 166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Aug. 6	9,892	8,830	+ 1,062	+ 3,384	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Aug. 7	16,154	15,353	+ 801	+ 2,636	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	July 30	4,016	3,860	+ 156	+ 214	60½	59½	„ 31	211,085	46,202,164	4,411,745	1·10	11·48	3,594	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,096	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	July 31	5,894	5,452	+ 442	+ 6 272	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	July 29	1,113	1,123	— 10	+ 541	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	July 27	136	128	+ 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	July 30	1,079	998	+ 81	— 192	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	July 28	2,482	2,314	+ 168	+ 1,332	15·25	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *b* Half-year's figures.

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THE
Electrical Engineer.
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WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Municipal Wiring.

It is to be regretted that the Dundee Town Council's desire to obtain Parliamentary powers enabling their Electricity Department to carry out wiring and similar work, should have called forth such a bitterly conducted opposition from a section of the local contractors. Mr. Richardson, his committee and officials, are merely anxious to promote the use of electricity and make the Department pay. They want to have the legal power to push forward the interests of the concern, and where necessary carry out work. But as the Incorporated Municipal Electrical Association quite correctly argue, the opposition to wiring powers being conferred on municipalities is a mistake. In practically every instance electrical engineers of municipalities would be only too glad to let out all wiring work to contractors, so that the trade would benefit very largely owing to the local authorities supplying the necessary capital and paying cash down, and, it may be added, in active canvassing all possible consumers and giving them technical advice. These are points that can be put before other nervous opponents besides those in Dundee.

End of Reigate Obstruction.

It will be remembered that we referred recently to the serious obstructions placed in the way of Reigate Corporation's electricity extension, owing to Lord Monson's agent demanding the prohibitive terms of ten shillings for every house connected with the mains on his building estate, and further that the mains laid in that district should be used only for houses on the estate. This was coolly asking the Corporation to place an enormous premium in favour of Lord Monson's property, at the expense of the ratepayers, and further exacting an extortionate revenue. The Council, of course, promptly refused, and we are glad to see that the agent then wrote that Lord Monson was prepared to forego rentals and to allow the cables to be laid subject to certain conditions, chiefly as regards reasonable use and maintenance. These conditions were as promptly accepted. Reigate is to be congratulated on the vigilance, business ability and firm stand of its councillors. Too many schemes for public benefit have been hampered and curtailed by undue rental and wayleave exactions on the part of landlords. Both municipalities and public utility companies are sufferers from this kind of procedure.

Wireless Linking Up.

A certain number of shipowners are showing a considerable amount of peevish opposition to Sir Edward Sassoon's Bill making it compulsory for passenger ships to carry "wireless" telegraphy equipments. Two main objections are advanced: first, that the best owners are already doing what the Bill seeks to make compulsory; secondly, that in many cases the equipment would be useless because of the absence of land receiving stations. As to argument one, if the better class shipowners are taking wise precautions, why need they grumble, because the law would only spur on the less enterprising? As to number two, the linking up of the British Empire by means of wireless stations, as exemplified in the notable case of the Pacific Islands, the offer of the Marconi Wireless Telegraph Company to establish stations in all the Portuguese colonies on easy terms, and similar enterprise elsewhere, shows how rapidly the meshes of the "wireless" web are being woven, which will soon bring passenger ships in frequented parts of every ocean within speaking distance of the land.

Electrical Production of Nitrates.

In a notable review of the whole sources of production of nitrates, which Mr. H. C. T. Gardner, F.C.S., contributes to the "Financier," the enormous hydro-electric establishments in Norway are referred to. Some of these, like the factory at Odda, which manufactures "Nitrolim," are run by British capital. But Mr. Gardner suggests that it is quite possibly that the production of nitrate compounds by the fixation of atmospheric nitrogen, might be profitably undertaken in this country, by means of electrical machinery run not by water power, but by Mond gas plant, or possibly various sources of waste heat. It is an interesting problem for the electrical engineer. Meanwhile, it is well to notice that the Badische Ainlin and Soda Fabrik have succeeded in fixing nitrogen from the air by means of a suitable electric flame.

Exhibitions.

Good progress is, we hear, being made in organising the Engineering and Machinery Exhibition, Manchester, October 14 to November 5. Next month the Naval, Mercantile Marine and General Engineering and Machinery Exhibition will be held at Olympia. Among the exhibitors at the latter will be the Witton-Kramer Electric Tool and Hoist Company, Adams Watkin & Company, Ltd., Chadburn's Ship Telegraph Company, Wallach Brothers, Ltd., the Worthington Pump Company, Ltd., Babcock & Wilcox, Ltd., Hindley & Sons, Fasnut, Ltd., and the "Lea" Recorder Company. During the run of the Exhibition meetings of a number of engineering societies will be held at Olympia; among other arrangements the following fixtures have been made: September 6, Junior Institution of Engineers; September 14, Institute of Metals; September 15, Institute of Sanitary Engineers; September 17, Institute of Marine Engineers; September 21, Society of Engineers; and September 24, Association of Engineers in Charge. Then next year an International Hygiene Exhibition will be held at Dresden. Among the sections will be: (1) Scientific Instruments and Apparatus; (2) Traffic Facilities on Land and Sea; (3) Machinery and Safety Appliances; and (4) Hospital Equipments, in which, of course, electrical apparatus will be included. Next year, too, it will be remembered, the Electricity and Land Transport Exhibition is to be held at St. Petersburg.

Mining Casualties.

Mr. J. A. Vaughan in his Presidential address to the Transvaal Institute of Mechanical Engineers, referred to in another column, devoted some attention to the casualties in the Rand mines attributed to electricity during the past eight years. The total is 86, of which 51 proved fatal. In this connection it is worth noting that Mr. Vaughan used the word *attributed*, advisedly, because, he said, "it is practically certain that in one or two instances the electric shock accidentally sustained was just the last straw that finished off the unfortunate. Again, in other cases quite a mild shock met with by persons in elevated or insecure positions has led to their falling and sustaining grave injuries—sometimes fatal." Those of us who have studied the subject nearer home know full well that in many cases electricity is blamed recklessly. On the other hand, Mr. Vaughan fairly enough called attention to the fact that the accidents recorded are only the serious ones, slight mishaps going unrecorded.

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Causes of Casualties.

It is interesting to follow Mr. Vaughan in his analysis of the recorded cases. Of the 68 accidents, 45 occurred above ground and 23 underground. In the former case 21 whites and 24 blacks were affected, in the latter 8 whites and 15 blacks. Mr. Vaughan's classification is as follows:—"Contact with escaped current underground, killed 1 white, 6 blacks; contact due to slipping and catching hold of wires underground, killed 5 whites, 4 blacks, injured 1 black; contact with electric wires passing over slimes or tailings or waste dumps, killed 1 white, 3 blacks; contact with falling wires, killed 3 blacks; contact with bare wires in or near a building, killed 1 white, 4 blacks, injured 1 black; contact through unauthorised approach, killed 2 whites, 10 blacks, injured 1 black; contact while engaged in presumed electrical work—on poles, switchboards, transformers, etc., killed 6 whites, 3 blacks, injured 10 whites, 3 blacks; carpenters, painters, etc., working on live switchboards or in live switch-houses or transformer houses, killed 2 whites, injured 1 white." Mr. Vaughan pointed out that low voltage is now guarantee of safety. But what appears to us as significant is that proper instruction as regards danger would result in greater immunity, for bearing in mind the great number of blacks employed, and also the special work of the whites, it would appear that these, equipped with a better knowledge, possess a relative immunity.

The Gas Campaign.

We are not at all astonished to find the statement made in connection with the recent move of the Finsbury Borough Council and its new contract for lighting the streets by gas turns out to be incorrect. Someone put forth the announcement that the 10 years' contract was granted to the Gas Light and Coke Company for the lighting of all its streets by inverted burner lamps because an increase in total illuminating power of 100,000 c.p. over the existing system of lighting was shown, with a reduction in cost of £525 a year. Moreover, that this decision was taken after the latest examples of gas and electric lighting had been carefully inspected and relative costs considered. Now, however, Mr. H. B. Renwick, general manager of the County of London Electric Supply Company, Ltd., plainly states that his company offered to submit examples of electric lighting free of expense to the Council, but this offer was declined. As regards the question of relative running costs, his company submitted a tender for lighting which gave an illuminating power three times as great as the existing gas lighting, and, moreover, showed a saving in running costs as compared with gas of over 14%. In spite of this, however, the company's offer was declined. Bearing this in mind, and the queer proceedings alluded to by another of our correspondents last week, it is clear that the gas campaign requires careful watching.

Lighting Tunnels.

A suggestion, the direct result of recent unpleasant happenings in railway carriages, that tunnels should be lit by electricity ought to be pushed vigorously, for it would conduce to safety and comfort. It is quite true that electricity is now so cheap and reliable that it could easily be applied in this way in all big cities and their neighbourhood, if not further afield on the main lines. The companies may resist the proposal, as they have done before, but public safety demands some remedy to the present state of affairs.

MINING ELECTRICAL APPLIANCES.

The Adnil Electric Company, Ltd., are holding a private exhibition of their colliery and mining specialities, comprising their signalling systems and telephones, at the Park Hotel, Cardiff. This will remain open until the 27th. From August 31 to September 10 the same exhibition will be held at the Metropole Hotel, Swansea. The equipment also embraces motors, cables, fans, liquid starters, and other appliances.

ELECTRIFICATION OF SUBURBAN RAILWAYS.*

By F. W. Carter, of Rugby.

The shrinkage of suburban traffic has for several years past proved a source of lachrymose complaint at many of the general meetings of our Railway Companies. The extensive tramway systems that radiate from most of our large cities provide a convenient, cheap and comparatively rapid means of transport with which the railways are ill-adapted to compete. Where a tramway runs directly parallel to a railway, it may be expected to secure the greater portion of the purely short-distance traffic, and it would seem that the distances over which its competition is effective are greater than might at first be supposed. At the general meeting of the London and North Western Railway, held on February 19, 1909, the chairman in discussing this point said that, "he would be unwilling to say what the distance was—it might be 10 or 12 miles—but after such a distance the railway was the more punctual and the more certain way for a man to get to his destination. Within the 10 or 12 miles the tramway competition was very severe, but beyond that distance the railways were not so much touched by the tramways." The advent of the motor-omnibus has also affected suburban railway traffic adversely, particularly in the neighbourhood of London, the flexibility of its route, its speed and general convenience giving it a great advantage in ministering to the needs of comparatively short-distance passengers.

With the main routes of street traffic worked by tramcars and auxiliary routes by motor-omnibuses, the railways as at present operated are at a great disadvantage, and bid fair to lose most of their suburban passenger traffic. The second report of the London Traffic Branch of the Board of Trade gives the loss of passengers by five railways as upwards of 12 millions in 1908 as compared with 1907, and of 47 millions in 1908 as compared with 1902, both figures being exclusive of season-ticket holders, and taking no account of the increase in the number of long-distance passengers indicated by the receipts.

The railway companies affected appear for the most part undecided between allowing their short-distance traffic to go, employing their energies in fostering the longer-distance traffic, and endeavouring to reduce the effective range of tramway competition by electrification of their suburban lines. The latter alternative, wherever it has been tried, has invariably succeeded in recovering a portion of the lost traffic, besides creating a more desirable traffic for longer distances by the improvement of facilities. Whilst it is by no means certain that local electrification would prove the best commercial policy in the case of all railways handling suburban traffic, it is the author's opinion that there is considerable scope for well-considered electrification schemes in this country.

Where a suburban railway is regularly used to near the limit of its capacity and there is still possibility of increased traffic, there is every reason to expect a commercial advantage from electrification. Both here and abroad the improved service has always been the means of largely increasing the traffic, whilst the capital cost is further justified by the greater use that can be made of existing lines and terminals under electrical operation. The cost of electrification should in fact be set against the cost of widening and improving the railway to accommodate the traffic in view.

In the more usual case, however, the management of a railway are compelled to estimate the chances of success from far less certain data. Consider, for instance, the line from Birmingham [New Street] to Sutton Coldfield and Four Oaks. It passes through a populous and growing residential district, feeding also one of the most beautiful pleasure resorts of Birmingham people. The present trains, of which there are about 30 per day in each direction, make a schedule speed, including stops a little over a mile apart, of approximately 18 miles per hour, the grades being rather severe. As the whole distance in question is little more than 8 miles, it is small wonder that the tramway, which now parallels the line for a considerable distance and offers a frequent service at low fares, takes the greater part of the traffic so far as it extends. Although the population served has largely increased in recent years, the passenger traffic on the railway appears to have decreased considerably since the opening of the tramway, and will doubtless decrease still further as the tramway is further extended. If this section of the railway were electrified, the schedule speed might be increased by 30% or 50% and trains run every 15 minutes or so throughout the day, say two-coach trains during hours of light traffic and six-coach trains during the busy hours. The capital cost of electrification and the expense of such electrical working could be very closely estimated. The real difficulty which confronts the management is in estimatng the increase in receipts which would accrue from the improved facilities. This is an economic problem to which no certain answer is possible. So many considerations enter into the matter that experience in one locality is no sure guide in making an estimate for another.

The appropriate method of treatment for any such problem in estimation is provided by the theory of probability. If from the experience of other electrified lines, and from knowledge of

* Paper read at the Summer Joint Meeting of the Institute of Mechanical Engineers and the American Society of Mechanical Engineers.

the particular district, such a curve as "A," Fig. 1, can be improvised—the abscissae of which represent the increase of passenger traffic resulting from a certain improvement in facilities, whilst the ordinates are proportional to the probability of such increase—the probable value of the advantage of providing the improved facilities can be deduced. Assuming the operating and capital expenses known, the net profit with any particular traffic can be deduced. Let the increase of profit above the old method of operation be represented by curve "B," and deduce curve "C," whose ordinate is the product of the ordinates of curves "A" and "B." Then the area of curve "C," as compared with that of the probability curve "A," gives the probable value of the advantage of providing the improved facilities. While the probability curve may be subject to considerable uncertainty, the result of such calculation as indicated above, if properly interpreted, is likely to be of much greater value than a figure derived from a simple estimate of the increase of traffic.

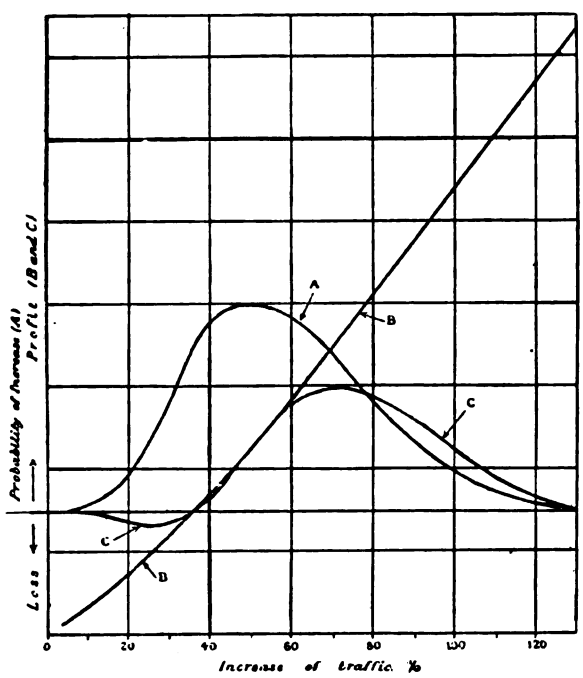

FIG. 1.—ESTIMATION OF PROBABLE PROFIT.

It has generally been found hitherto that the increase in traffic due to electrification has exceeded the estimates formed of it. Thus at the February, 1905, meeting of the Lancashire and Yorkshire Railway Company, the chairman stated, concerning the electrified Liverpool-Southport line, that "the increase in the traffic had exceeded their most sanguine expectations." At the February, 1906, meeting of the North Eastern Railway Company, the deputy chairman, referring to the Tynemouth electrification, said that "in the last half of 1903, with steam traction, they had 2,844,000 bookings, and in the last half of 1905, with electric traction, they had 3,548,000, an increase of in round figures, 25%. In 1903, the gross amount of money earned with steam traction was £129,000, and in 1905, with electric traction the gross amount of money earned was £151,000, and they had run in 1905 twice as many trains as in 1903. In 1903, to earn the £129,000, the running expenses amounted to £42,761, while to earn the £151,000 it cost £47,799, which was only £5,000 more to do twice the work in 1905 that they did in 1903. He would give the figures in another way, as many persons were interested in train-mileage cost. In the electric traction on the 31 miles of suburban railway in the Newcastle district they had practically doubled the train-mileage and doubled the accommodation of the public, and the running cost per train mile, allowing for depreciation of stock, etc., had been with electric traction about 9d. per train-mile as compared with 1s. 5½d. per train-mile under steam conditions. They had run smaller trains but there were more of them. They were thus able to serve the public better and at the same time to make a better profit for themselves." At the February, 1907, meeting of the North Eastern Railway Company, the deputy chairman explained that in the last half of 1906 they had carried 4,195,339 passengers on the electrified lines as against 3,548,206 in the corresponding half of 1905—a further increase of 18%, making a total increase of 47½% as compared with the last half-year that steam operation was exclusively employed. At the last February meeting of the London, Brighton and South Coast Railway Company, the chairman announced that the increase in passengers on the elevated electric line between Victoria and London Bridge for the two months (December 1909, and January, 1910) during which the line had been open, was—as compared with the corresponding period of 1908–9—440,536, or 63%.

It has been stated above that the capital outlay and operating expenses can be closely approximated in any particular case. The amount will depend largely on the difficulty of the proposed schedule. It is in the power of electricity to improve very greatly on the performance of steam trains; but the greater the improvement the higher the capital and operating costs, and the greater the attractiveness of the line. It is a matter of nice estimation and computation to determine what improvement of service will result in the greatest commercial advantage to the railway. The Tynemouth lines and the Liverpool-Southport line do not differ greatly in the distance between stops. The schedule speed is, however, considerably higher on the Liverpool-Southport line, and the effect of this on operating expenses is to some extent revealed in the above extract from the statement of the North Eastern chairman as compared with that of the Lancashire and Yorkshire chairman at the February, 1906, meeting: "they found after a full year's experience that the cost of electric working, as they had expected, was, when proper allowances were made for the depreciation of the more costly plant, slightly higher per train-mile run" (than that of a steam working). Other features doubtless affect the comparison,* but the greater portion of the difference in running cost can probably be ascribed to the difference in the schedule speeds.

The electrification of a steam railway can, of course, be considered commercially expedient only when the estimated net profit under electrical operation exceeds that under steam operation by more than the interest on the extra capital involved. It is chiefly the burden of capitalisation which limits electrification to lines of heavy traffic. The extent of the burden is in practice very variable. The total capital involved in the Tynemouth electrification to date is approximately £244,000, and the annual electrical train-mileage, 1,215,000; taking the interest at 4%—which appears to be about the average value of railway investments here—the capital burden is seen to be about 1·93d. per train-mile. Again, the capital involved in the electrification of the South London elevated line has been given as approximately a quarter of a million sterling,† and the yearly train-mileage is at present some 375,000, to be eventually increased to approximately 585,000 miles.‡ The burden of the capital is, therefore, about 6·4d. per train-mile at present, decreasing to 4·1d. if the improved service can be realised without adding to the capital expense§. The capital burden in the case of the Mersey Railway has been given as 4·3d. per train-mile, and in the case of the Lancashire and Yorkshire electrified lines as about 2d. per train-mile.‖ These two cases, of course, include generating station, which is absent in the first two.

An indispensable requirement to the success of any system for working suburban traffic is immunity from all forms of breakdown competent to delay the service. In this respect modern electric railway apparatus, the design and construction of which has been developed by arduous experience, if chosen with reference to the nature of the service and maintained with care, leaves little to be desired. Even when first installed the troubles are usually of a minor character, and the consequent delays unimportant, whilst ordinary operation is exceedingly reliable so far as the electrical plant is concerned. The much greater loss of time on the Metropolitan District Railway, as compared with the Tube lines, is almost entirely due to the fact that District trains operate to a consdierable extent over foreign lines, worked for the most part in the interests of steam trains.

The comparative immunity from breakdown is duly reflected in the low maintenance costs of the train equipments. Mr. Chapman dealt with this subject at a valedictory dinner given in his honour on February 7, 1910, on the occasion of his retirement from the position of Chief Engineer to the Underground Company. He said that they (the Underground Railways Co.) "owned over 800 motors, and that every one was the same throughout, no matter whether it was working on the District or a 'Tube,' under a car or on a locomotive, all were interchangeable; and to-day, several years after the original purchase, they were negotiating for some more of the same motors to meet the increased traffic requirements of the District Railway. On no one of their properties did the cost of rolling-stock maintenance and repairs exceed 0·6d. per car-mile. The 10 District Railway electric locomotives, now 5 years old, made 1,300 miles per day at a cost of ¼d. per mile for all maintenance and repairs. Two of them coupled handled a London and North Western Railway 9-coach train to Mansion House far better than a steam locomotive had ever done. The maintenance cost was 1d. per train-mile. The North Western costs for maintaining a steam locomotive were 4d. per mile; the average cost for all English railways was 3½d. per mile. Five years after this system had been designed, the Pennsylvania Railway had experimented for two years at a cost of $200,000 to determine the electric system

* From Board of Trade Railway Returns, 1908, it would seem that the coaches per train average 3·4 for the L. and Y. Railway, and 3·1 for the N.E. Railway. See also President's Address, Proceedings, I. Mech. E., 1909, Part 2, p. 432.

† See "Electrical Review," vol. lvi, p. 953.

‡ See "Light Railway and Tramway Journal," vol. xxii. p. 17.

§ This would involve running each of the present eight trains an average of 73,000 miles per annum.

‖ Proc. Institution of Civil Engineers, vol. clxxix, pp. 42 and 119.

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to be adopted for bringing their trains through the Hudson River Tunnel into their magnificent New York terminal, and had decided in favour of the same system as they (the Underground Railways Co.) had to-day."

The railways in this country operated wholly or in part electrically are 18 in number, working over a total of approximately 200 miles of route and 410 miles of track. The trains are worked by 87 locomotives and 821 motor-coaches. The aggregate nominal power of the driving motors is approximately 360,000 h.p., of which 184,000 h.p. is provided by one type of motor alone, namely, that used exclusively by the railways operated by or in conjunction with the Underground Electric Railways Company, London,* and partly by the Metropolitan Railway.

Of the 18 electric lines 13 are in the London area (including 7 tube lines), 3 in the neighbourhood of Liverpool, one at and near Newcastle, and one between Heysham, Morecambe and Lancaster. As full details of all the lines have been published, there is no necessity to give more than a brief comparative summary here.

The oldest of the London lines is the City and South London Railway, which was not only the first tube railway but one of the first electric railways to be constructed, having been opened for traffic in 1890. It extends for 8 miles, from Clapham Common to Euston, and is carried in a 10 ft. 6 in. tube. It is unique among electric railways in transmitting high potential continuous current (2,000 volts) and distributing to the trains by the three-wire system, the up and down track-conductors being of opposite polarity, whilst the track rails form the middle conductor. The traffic is still worked exclusively by electric locomotives.

The Waterloo and City line of the London and South Western Railway is also comparatively old as electric railways go. It is 1½ miles long, and is carried in a 12 ft. tube. The trains are worked by motor-coaches, mounting for the most part gearless motors, directly controlled. The track rails are used as return conductors.

The Central London Railway was the first to employ polyphase transmission of power and conversion to continuous current at sub-stations. The line is 6½ miles long, and is carried in a 11 ft. 8 in. tube. The traffic was originally worked by locomotives, but is now handled entirely by multiple-unit trains, using the electro-magnetic system of control, this railway having been the first to employ the multiple-unit system of operation. Power is supplied to the trains by a third rail, and the track rails are used as return conductors.

The Great Northern and City Railway is the only tube sufficiently large to accommodate main line rolling stock, the minimum internal diameter being 16 ft. It is 3½ miles long, and is supplied with power from a central power-station, which feeds directly to positive and negative conductor rails. The trains are of the multiple-unit type, using the electro-magnetic system of control.

The Underground Electric Railways Co. of London operate three tube lines, namely the Baker Street and Waterloo Railway (4¼ miles), the Great Northern, Piccadilly and Brompton Railway (9 miles), and the Charing Cross, Euston and Hampstead Railway (8 miles). These are all run in tubes of 11 ft. 8 in. minimum diameter. Power, which is generated at the Company's great power-station at Lots-road, Chelsea, is supplied to the railways through 12 sub-stations, being distributed to the trains by positive and negative conductor rails. The traffic is worked exclusively by multiple-unit trains using the electro-magnetic system of control.

The Metropolitan District Railway comprises 25 miles of route, but, including running powers, operates over 56 miles in all. Of this, 41 miles is supplied with power from Lots-road power-station, through 15 sub-stations, it being distributed to the trains by positive and negative conductor rails. The District trains are of the multiple-unit type, using the electro-magnetic system of control. A number of foreign trains are brought to the company's lines at Addison-road Station, whence they are hauled by electric locomotives. The Whitechapel and Bow Railway and the electrified portions of the London, Tilbury, and Southend, and the London and South Western Railway, are worked in conjunction with the District, using the same or similar rolling-stock, and their route mileage is included in the 41 miles given above.

The Metropolitan Railway has some 26 miles of its lines electrified. It employs the same system of operation and the same location of conductor rails as the Metropolitan District Railway; the Inner Circle being, in fact, jointly worked by the two companies. The Metropolitan Company generate power at their own power-station at Neasden, which feeds their lines through 9 sub-stations. The trains are, for the most part, of the multiple-unit type, both the electro-magnetic and the electro-pneumatic systems of control being used. A number of trains are made up of the old steam stock and hauled by electric locomotives, which also handle the goods traffic over the electrified lines.

* The Metropolitan District; Baker-street and Waterloo; Charing Cross, Euston and Hampstead; Great Northern, Piccadilly and Brompton; London, Tilbury and Southend; and Whitechapel and Bow Railways.

† See "Tramway and Railway World," vol. xx, p. 325.

The Hammersmith and City Railway is a joint Metropolitan and Great Western line. Except on the Metropolitan section between Aldgate and Praed-street Junction, the power is supplied by the Great Western Co.'s power-station at Park Royal. The trains are of the multiple-unit type, the electro-magnetic system of control being used.

The electrified section of the London, Brighton and South Coast Railway extends for 8½ miles from Victoria to London Bridge Stations, *via* Brixton. It has the distinction of being the first of the London railways to adopt the single-phase system of operation. It is supplied with power at 6,600 volts, 25 cycles single-phase, by the London Electric Supply Corporation the feeding cables being run to a central distributing cabin at Denmark Hill, through a metering cabin near Queen's-road Station. Thence the power is conveyed to a number of switch cabins which feed the overhead track conductors. The outer of the concentric distributing cable is bonded to each length of track rail and forms the return conductor. The trains are of the multiple-unit type, employing the electro-magnetic system of control.

The Liverpool Overhead Railway is one of the oldest of electric railways, having been opened for traffic in 1893. It is 7 miles long, and carried on an elevated structure alongside the docks. It is a third-rail line, fed from a power-station near its centre. The service was reorganised and greatly accelerated in 1902. The trains are worked by means of motor-coaches, the motor control being directly operated by the driver.

The Mersey Railway has 4¾ miles of route, connecting Liverpool with Birkenhead by means of a sub-aqueous tunnel. It was converted from steam to electricity in 1903, largely on account of the difficulty in maintaining efficient ventilation in the tunnel. Power is supplied from a central power-station directly to the conductor rails. The trains are of the multiple-unit type, the electro-pneumatic system of control being used.

The Lancashire and Yorkshire Railway have some 28 miles of route electrified in the neighbourhood of Liverpool. Power is generated at Formby power-station, and transmitted to four rotary sub-stations, whence it is distributed to the third rail, and also to a number of battery sub-stations. The return conductor is an uninsulated fourth rail, bonded to the track rails. The trains are worked by motor-coaches, of which the motors are for the most part directly controlled by the driver, although a few multiple-unit trains have recently been introduced, using an electro-magnetic system of control.

The North Eastern Railway have about 30 miles of electrified route in their Tynemouth lines. Power is bought from the Newcastle Electric Supply Company, and transmitted three-phase to the five sub-stations which feed the conductor-rails. The track is used as return conductor. The trains are of the multiple-unit type and employ the electro-magnetic system of control. Some of the later coaches are equipped with commutating-pole motors, the North Eastern being the first railway in the country to use this type. A quantity of fish and parcel traffic is handled by special motor-vans, whilst two electric locomotives handle goods trains, particularly on the Quayside line.

The Midland Company's electrified line at Heysham is an interurban one of an experimental nature, it being the first single-phase railway opened for traffic in this country. It comprises some 8 miles of route, and as there are only three stations, the average length of the run is about 4 miles, so that the service has little in common with that on a suburban railway, lacking the features which go to make the latter class of service particularly difficult to operate. The line is fed from the harbour power-station at Heysham. The trains are of the multiple-unit type, both the electro-magnetic and the electro-pneumatic systems of control being used.

It will be seen that by far the greater portion of the electrically operated traffic is worked by motor-coaches rather than separate locomotives. This method of operation is peculiarly adapted for working suburban railways and will no doubt remain the standard. The chief advantage of locomotive operation is that the greater portion of the electrical apparatus is immediately under the eye of the driver. If the apparatus were less immune from breakdown this would be worth making considerable sacrifice to attain, but practically the advantage is small, as balanced against the advantages of motor-coach operation. The multiple-unit system of control in which the motors on any bogie and the corresponding motor controllers form a unit—all such units on a train being operated from the driver's cab—is practically universal in the latest equipments, as well for locomotives as for motor-coaches. Most of the multiple-unit trains used on surface-lines carry the motor-controlling apparatus suspended on the underframe of the motor-coach. In the case of the tube lines, however, it is invariably located inside the motor-coach, in order to be accessible in case of emergency. In the smaller tubes the control compartment is placed over the motor-bogie on a raised platform.

Most of the passenger-coaches are of the saloon type; there is, of course, nothing in the nature of electrical working to render this type of coach indispensable, although the shortness of the station stops and the high rates of acceleration usual in electrical service, render it preferable from the operating point

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of view. Some of the most popular of the Metropolitan Railway trains, however, are of the compartment type, being bogie trains, dating from the time of steam operation, converted for electrical working.* These trains consist of seven coaches, of which the end ones are motor-coaches; they weigh, unloaded, some 172 tons and seat 400 passengers—120 first class and 280 third class. The controlling apparatus is located in what was formerly the guard's compartment, of which the fore end forms the driver's cab.

The London, Brighton and South Coast Railway have sought to combine some of the advantages of both types of coach in the new rolling-stock for their South London Elevated Electric line. The coaches are of the corridor type, being divided into compartments, and having side doors, but having a corridor running the length of the coach for distributing the passengers. The trains consist of three coaches, of which the two end ones are motor-coaches; they weigh unloaded some 138 tons and seat 188 passengers.

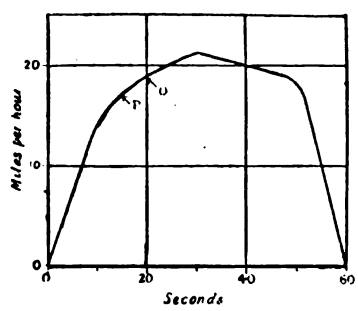
Although most of the railways in this country employ the vacuum brake, the electric railways, with the exception of the Lancashire and Yorkshire and the Midland, have adopted the Westinghouse type of brake. The chief reason for this is that compressed air can be stored to take off the brakes at a moment's notice. If the vacuum brake be employed it is necessary to use a rather large exhauster, in order to fulfil the function of the large ejecter on a steam locomotive in producing a vacuum rapidly. The space and material are, therefore, not used to advantage in this system as compared with a pressure system. The locomotives used on the London Underground Railways, having to work trains of all kinds, are fitted to use either system.

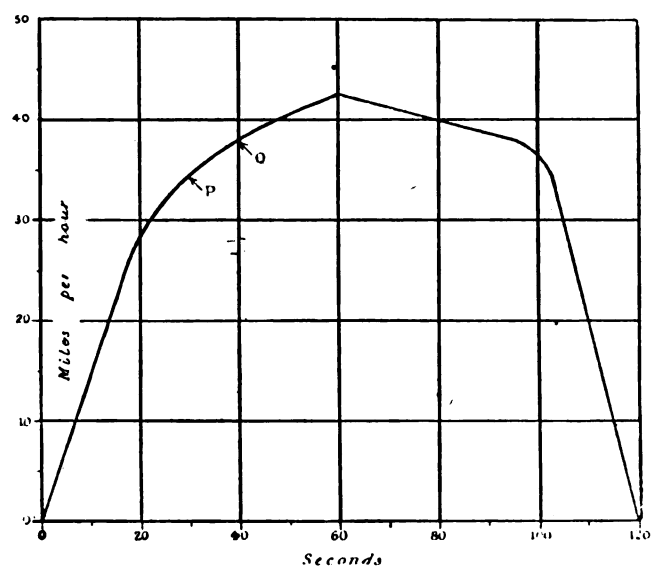
In suburban service the greater part of the energy expended is used in giving speed to the train and is utlimately dissipated in the brakes. Other things being equal, therefore, the more frequent the stops the greater is the energy required per mile, and the more difficult the service. The energy-consumption per ton-mile, unless abnormal, is, in fact, a very good measure of the difficulty of a service. If this were more generally realised the world might be spared some of the absurd comparisons of energy-consumption between different systems, in which credit is claimed for obtaining a low energy-consumption, which is really due to comparatively easy service. As the author has pointed out elsewhere,† the figures derived from test of 42 watt-hours per ton-mile for the energy-consumption of the Central London Railway trains and 137 watt-hours per ton-mile for the Liverpool Overhead Railway trains, are strictly comparable and indicate no more than totally different services on totally different railways.

If it be granted that the natural and normal energy-consumption per ton-mile is a reasonable measure of the difficulty of a schedule, an even more reasonable measure is to be found in a certain acceleration immediately expressible in terms of the particulars of the service, namely, the acceleration that would cause the train to reach a speed equal to the mean running-speed in a distance equal to that between stops. This is merely a dynamical result, and in order to show it, let Figs. 2 and 3 represent speed-time curves corresponding to two schedules, the curves being such that that of Fig. 3 is simply that of Fig. 2 magnified twice in every direction. The distance represented in Fig. 3 is then four times that in Fig. 2. At corresponding points P on the two curves, the acceleration, and therefore the tractive effort per ton necessary to produce it, will be the same. The power per ton required at P to produce the acceleration, being proportional to the tractive effort and speed, is twice as great in Fig. 3 as in Fig. 2. The energy per ton required to accelerate between corresponding points P and Q, being proportional to the power and to the interval of time, will be four times as great in Fig. 3 as in Fig. 2. But the distance is also four times as great, and thus the energy per ton-mile used in accelerating—probably some two-thirds of the whole—is the same for the two services. If the mean train-resistance per ton were the same for the two curves, the energy per ton-mile required to overcome the resistance would also be the same, and we might then assert that the total energy-output per ton-mile would be the same in the two cases. As it is, there is a small error affecting a comparatively small portion of the energy, which will have to be neglected. This is in general of little consequence in cases in which it would be expedient to employ the result, that is, in suburban service, where a ratio of four to one in distance with similar speed curves is, of course, a very exaggerated case. It will be seen that the acceleration referred to above, which will be called the specific acceleration of the schedule, is the same for the two curves, being the square of the mean running speed divided by twice the distance. It will also be seen that the method is perfectly general: so long as the speed-time curves for two services are similar the specific acceleration will be the same, and the energy output of the equipments practically the same. It follows that of two services that having the higher specific acceleration may be expected to show the higher energy consumption per ton-mile. Also that if two services have the same specific acceleration but differ in energy consumption the higher can be reduced, in so far as it is not due to lower equipment efficiency, by running so as to assimilate its speed-time curve to that of the lower.

The specific acceleration of a schedule is a better index of the difficulty of the schedule than the energy-consumption, inasmuch as it is independent of the equipment efficiency and of the particular manner of running the schedule, in effect reducing equivalent services to the same mode of operation. This, of course, presupposes that the line is not specially graded to reduce the difficulty of operation. The Central London Railway, for instance, was so laid out that each station is at the top of a grade; thus energy that would otherwise be dissipated by the brake shoes is stored and used for accelerating—making the line easier to work and the energy-consumption lower than would be indicated by consideration of specific acceleration alone.

The above is an application of a method which the author has more fully elaborated elsewhere. The following Table gives some characteristic schedules arranged in order of difficulty as indicated by the specific acceleration:—





FIGS. 2 AND 3.—SPEED-TIME CURVES CORRESPONDING TO TWO SCHEDULES.

TABLE.

Line.	Average distance between stops.	Schedule speed.	Time of stop	Average speed excluding stops.	Specific acceleration.
	feet.	m.p.h.	secs.	m.p.h.	m.p.h. per sec.
Liverpool Overhead ..	2,145	19·5	11	22·9	0·179
Liverpool-Southport ..	6,535	30	15	33·4	0·125
Underground, Inner Circle	2,555	15·7	20	19·2	0·106
Baker Street and Harrow..	5,000	23	20	26·6	0·104
South London Elevated ..	4,540	21·5	20	25	0·101
Hammersmith and City ..	2,830	16	20	19·2	0·096
Central London	2,540	14·7	20	17·7	0·090
North-Eastern, Tynemouth	6,000	20·5	30	24·1	0·071
Midland, Heysham-Morecambe	23,500	26·7	120	33·4	0·035

A difficult service—in the sense of a service in which the specific acceleration is high—is one in which it is advisable, in the interests of low energy-consumption, to employ high rates of acceleration and retardation; in any easy service this is of smaller consequence and hardly worth securing at the cost of heavy mechanical strains on the bogies, etc., with the great draught of power incident to the use of a high rate of acceleration. The account of the tests on the Liverpool overhead trains indicated a maximum rate of acceleration of 4·2 ft. per second*

*See *Tramway and Railway World*, vol. xx. page 325.

† Proceedings, Rugby Engineering Society, vol. vi. p. 39; see ELECTRICAL ENGINEER, vol. xliii. p. 303.

* "The Engineer," vol. xciii., p. 284.

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(2·9 miles per hour per sec.), and this is, perhaps, as high as it is advisable to employ in service. The author has a record of a run actually made with a coach carrying a motor on each axle, in which an average rate of acceleration of 4·2 miles per hour per second was maintained until a speed of 21 miles per hour was reached (see Fig. 4). The test was made with a view of showing the possibility of electrical equipments in this connection, and the acceleration was certainly faster than would be considered comfortable to passengers.

During the period of acceleration by controller notching, considerable energy loss is inevitable in the equipment. In the continuous-current system the average equipment efficiency during notching is usually only about 57%, the remaining 43% being lost in the motors, rheostats, etc. It has been hastily assumed by some that the avoidance of rheostat losses in the single-phase system would result in much lower losses and higher mean efficiency during notching. That this is an unwarranted conclusion is shown by the authors of a recent Paper on the Heysham electrification,* who, although by no means blind to the merits of the single-phase system, found as the result both of test and calculation, that the mean efficiency of the equipment during notching was only 56% in the cases considered. The efficiency after notching is, of course, considerably higher for continuous-current than for single-phase equipments.

The claim that the performance of a suburban electric train can be very closely predetermined, may seem an extravagant one, until it is considered how very few are the conditions on which it depends. The relation between the attractive effort and speed of a given motor is perfectly definite † at any given voltage

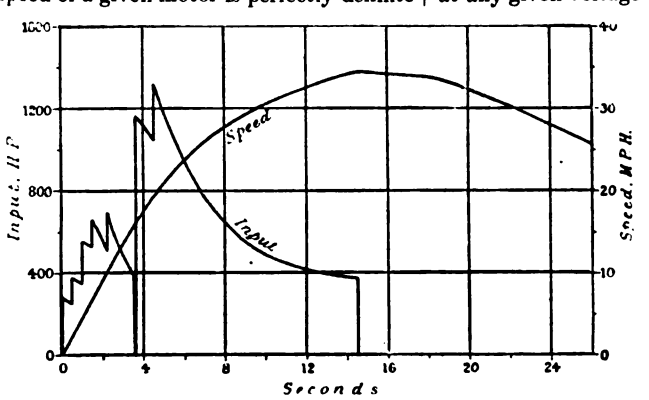

FIG. 4.—TRAIN CHARACTERISTICS.

as is the current taken, whilst different motors of the same type agree closely in their characteristics. Assuming the train known as to weight, size, etc., the resisting forces due to grades, inertia and train-resistance are known. It, therefore, requires a dynamical calculation of no great difficulty to determine the effect of the motors on the train for any particular route or schedule. The quantities most likely to be subject to some uncertainty beforehand are the voltage at the train and the train-resistance. In suburban work, however, a small error in these has but little effect either on the schedule speed or energy-consumption. Perhaps an idea of the accuracy with which the running can be predetermined will be best conveyed by disclosing that the author's practice, in making a guarantee of energy-consumption, is to compute it as closely as possible under the expected conditions of test and add 5% to cover bad driving and other unforseen contingencies. Such a guarantee would, of course, be of little use unless accurate instruments were available for making tests. Train-testing instruments should be specially designed for the work, so as to secure exceptionally large torque and heavy damping. The delicacy of ordinary stationary instruments renders them useless for train-testing where they are subject to great vibration in all directions.

These schedule calculations are easy and commonplace, but quite inadequate by themselves to determine whether an equipment is suitable for a given service. More important in this connection are the calculations involving the magnitude and distribution of the losses in the motors, with the facilities for transferring and dissipating the heat generated. Such calculations are, however almost necessarily confined to the designers of equipments, as the data on which they are based are not generally available. In order to give a rough idea of the quantities involved, it may be stated that the ultimate temperature rise of the hottest accessible part of an ordinary railway motor, totally enclosed and without forced ventilation, as measured by centigrade thermometer after continuous service, is given approximately by :—

$$T = 7\ W\ w^{-\frac{3}{4}},$$

where W is the mean motor loss in service (not including gear loss) in watts, and w is the weight of the motor in lb., excluding gear and gear case. The motor losses in suburban service usually take from 6¾% to 7% of the input to the driving equipment‡ in the continuous-current system, and from 15% to 18% of this input in the single-phase system. The great motor losses incident to the single phase system form the foundation of all the objections raised to the use of this system for suburban service.*

The heating of the motors has always been a limiting feature in the design of equipments for this class of service, and the practicable and desirable means of dealing with it are well understood. The use of forced draught for cooling the motors, whilst practicable for locomotives and single cars, is quite out of place on multiple-unit trains intended for suburban service, where, since the equipment may not be inspected for hours together, it cannot fail to lead to breakdown, increasing maintenance charges and causing delays to traffic.†

Fig. 5 gives speed, power and motor-loss curves corresponding to typical suburban schedule runs with continuous current and with single-phase equipments, the former of which carries 20 tons per motor and the latter 23 tons. Figs, 6 and 7 show the

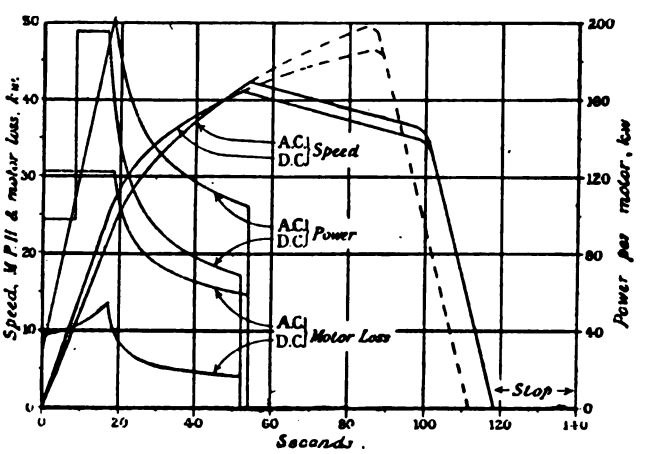

FIG. 5.—TRAIN CHARACTERISTICS.

corresponding motor characteristics. It will be seen that the great difference between the systems is in the motor loss, which amounts to 6·75% of the input in the continuous-current case and to 17·8% in the single-phase case. Although both motors are dynamically capable of working the service, the former alone has sufficient thermal capacity for the purpose, the other having to dissipate three times as much energy as it can get rid of by natural cooling.

The author has confined his remarks to the subject of "Suburban Electrification," inasmuch as there appears little

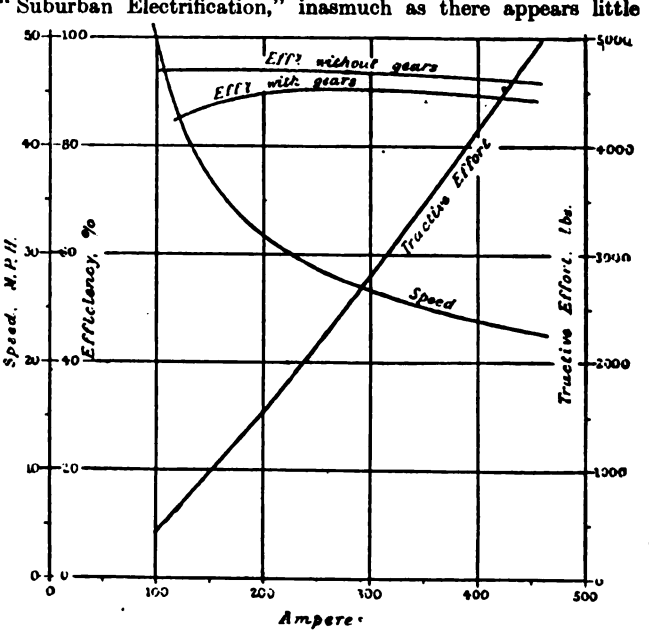

FIG. 6.—CONTINUOUS-CURRENT MOTOR CHARACTERISTICS.

prospect at present of general electrification of railways in this country. The properties which give to electrical working its predominant advantages in the case of heavy suburban service become of minor importance when the distance between stops is considerable and the service infrequent. This matter was dealt with by Mr. Aspinall in his Presidential Address,‡ and having also been recently discussed by the author§ need not be further pursued. Whilst it is, perhaps, gratifying to the electrical engineer to reflect that he can propose means fully competent to

* Proceedings, Institution of Civil Engineers, vol. clxxix., pp. 188 and 189.
† But subject to small known variation with temperature.
‡ That is, motors and rheostats.

* See Proceedings, Institution of Electrical Engineers, vol. xxxvi., page 253; also Proceedings, Institution of Civil Engineers, vol. clxvii., page 88, and vol. clxxix., p. 138 et seq.
†In this connection, see "Electric Traction on Railways," by Phillip Dawson, page 165.
‡ Proceedings, I. Mech. E., 1909, Part 2, page 425.
§ Proceedings, Rugby Engineering Society, vol. vi, page 47. See ELECTRICAL ENGINEER, vol. xliii, page 305.

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work the whole railway traffic of this country and can offer three distinct methods of doing it, it is futile as things are to regard the problem of electrification from any other point of view than that of the ultimate commercial advantage of the railway companies. The author's investigations have convinced him that in this country at least the commercial advantage is only demonstrable in general in the case of heavy suburban service. Even here it should not be taken for granted, for the margin in favour of electrification is by no means overwhelming. This much can be affirmed, however, that where there is any considerable suburban traffic, an investigation of the cost of electrification and the economic results of providing improved facilities will repay the trouble and expense, and in many cases, justify proceeding with the conversion.

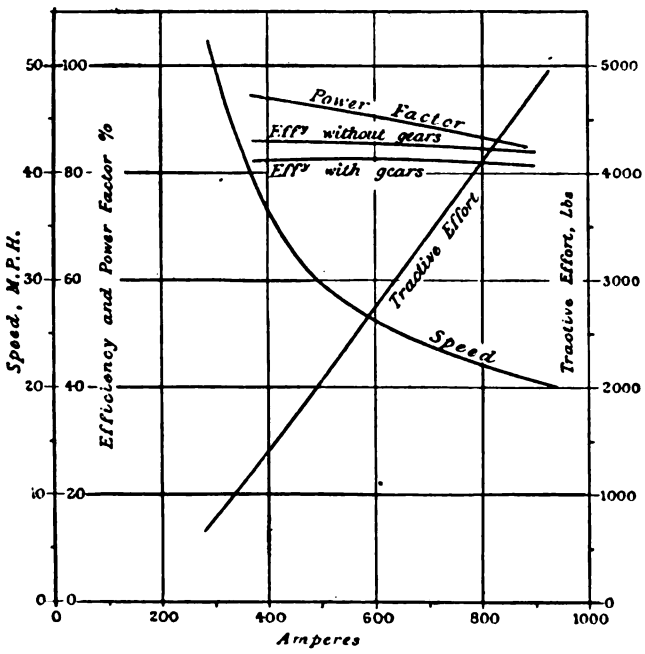

FIG. 7.—SINGLE-PHASE MOTOR CHARACTERISTICS.

It will be understood that the above remarks are intended to apply to the electrification of existing steam-operated lines. The case of entirely new railways is different and much more favourable to electrical operation. In laying out a new branch to an existing railway again, it may be well worth while to consider electrical operation, the capital cost of which might be more than saved in the cheaper roadbed, since steep grades are much less objectionable on an eledtrical than on a steam road. Of course, there are likely openings for local electrification on existing railways even apart from suburban systems. It might, for instance, be found profitable to work the purshers on the Bromsgrove incline electrically. It is quite possible, again, that where electric power is already available at goods yards and docks, the shunting could be more efficiently carried out by specially designed electric locomotives, fed perhaps by a suitable surface-contact system, than by steam locomotives, that would seem to be uneconomical for such work. For ordinary main-line work, however, there is at present no indication that the steam locomotive can be superseded with advantage in this country.

ELECTRICITY IN CONSTANTINOPLE.

News comes to hand of a pleasant instance of British enterprise in the Levant. It appears that the Chirket-i-Hairie Company, of Constantinople, have decided to rebuild and refurnish their shipbuilding yard and engineering works, bringing them into the most up-to-date condition. The new buildings will consist of boiler-shop, foundry, machine tool shop, generating and accumulator houses, joiner's shop, and pattern, machinery and wood stores, etc., and will cover an area of some 12,000 square yards. Two new slipways are to be introduced into the yard. New machine tools throughout, including two 20-ton overhead travellers, and some 40 to 50 electrical motors. The whole of the works will be electrically driven, and the yard electrically lighted. Gas engines and gas producer plant will be installed, and the whole of the equipment is to be ordered from England. Messrs. William Sprowson & Son, of Constantinople, have been appointed consulting engineers and architects for the entire plant and new buildings.

STANDARD SPECIFICATIONS FOR TRANSFORMERS.

Circular No. 22 of the American Bureau of Standards is concerned with "Standard Specifications for Transformers, Oil-Immersed, Self-Cooled, 60-Cycle, 2,200-Volts," and is given below :—

PROPOSALS.

1. Bidders shall include in their proposals complete information with reference to the following characteristics of the transformers which they offer, and no bid will be considered with guarantees inferior to those specified in Table I.: Core loss; copper loss under full load; efficiency; regulation; weight; dimensions (sketch or drawing).

These data shall apply to a temperature of 25° C. All other factors being equal, preference will be given to the apparatus having the best performance characteristics.

GENERAL.

2. *Type, Frequency, and Voltage.*—These transformers shall be either of the shell type or of the core type, shall be oil-immersed and designed for operation on 60-cycle circuits. The primary voltage shall be 2,200, and the secondary shall be so arranged that either 110 or 220 volts may be obtained with 2,200 volts on the primary.

3. *Materials and Workmanship.*—The materials entering into the construction of these transformers shall be of the highest grade, and of a quality and character best suited to the purpose in hand. The workmanship shall be first-class in every respect and shall meet with the approval of the representative of the purchaser.

4. *Rating.*—Transformers shall be rated at the number of kilowatts which they can deliver without exceeding the specified rise of temperature when operating at unity power factor and under normal conditions of frequency and secondary voltage.

5. *Name Plate.*—Each transformer shall bear a name plate, which shall state name of maker, serial number, type, and kilowatt capacity of the transformer, also the primary and secondary voltages and the frequency for which the transformer is designed.

DETAILS OF CONSTRUCTION.

6. *Cases.*—Transformer cases shall be made of cast-iron or of sheet-iron fastened to cast-iron bases in a satisfactory manner and provided with cast-iron covers. Eye-bolts or hooks shall be provided for handling the transformers filled with oil. Cases shall be free from leaks, and shall be impervious to oil. Covers shall be provided with felt or other suitable gaskets. The cases of all transformers above 5 kw. capacity shall be provided with oil plugs for removing the oil from the case. Oil gauges shall be provided for any individual case where conditions render their use expedient, and in such instances they will be separately specified.

7. *Hangers and Cut-Outs.*—Unless specified to the contrary, transformers up to 50 kw. shall be provided with hanger irons for supporting the transformers when mounting same on poles. Two plug cut-outs shall be provided for the high-tension side of each transformer.

8. *Leads and Connection Boards.*—Four secondary leads shall be brought out of the case through porcelain bushings, which shall be sealed into the case with a suitable compound which will not soften sufficiently to flow at any temperature less than 90° C. Two primary leads shall be brought out in a similar manner. The ends of the primary coils shall be brought to a convenient connection board of porcelain or other suitable material within the case, and so arranged that the primary coils may be put in series or in multiple.

9. *Core.*—The core shall be built of laminated sheet steel, so firmly assembled that no buzzing is perceptible, and shall be non-aging. At the option of the purchaser on artificial aging test may be made upon a sample of the core material or upon a finished transformer.

10. *Windings and Insulation.*—The primary coils shall be insulated from the secondary by a shield of ample dielectric strength. Each turn shall be thoroughly insulated and the voltage between adjacent turns kept as low as is consistent with good design. Coils shall be carefully taped and leads shall be brought out in a thoroughly workmanlike manner. Coils shall be dried by the vacuum process, and impregnated

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with an insulating compound which is not hygroscopic and not soluble in nor acted upon by the transformer oil at operating temperatures, or else the insulating material used shall be moisture-proof. The windings shall be so disposed as to permit the free circulation of oil and the maintenance of a nearly uniform temperature throughout.

11. *Oil.*—The oil used in these transformers shall be a pure mineral oil obtained by the fractional distillation of petroleum, unmixed with any other substance. It shall be prepared and refined especially for the purpose and shall be free from moisture, acid, alkali, and sulphur compounds. The flash point of the oil, determined in a closed cup, shall be not less than 170° C., and on cold test it shall not begin to solidify, and no wax shall form in the oil above zero degrees C.

Sufficient oil shall be furnished to completely immerse core, windings, and connection board.

The oil shall withstand a breakdown test of 30,000 volts between spherical surfaces of ·05 centimeter radius, 0·40 centimeter apart.

Tests and Performance.

12. *Inspection Requirements.*—All transformers will be tested at the place of manufacture, in the presence of a representative of the purchaser, if the latter so desires. The contractor shall give ten days' notice to the purchaser of his readiness to make the specified tests, and shall furnish all labour, materials, instruments, observers, complete facilities for tests, including those enumerated in paragraph No. 14, and such information regarding the transformers as is available without additional tests, as the purchaser's representative may consider necessary for a definite opinion of their acceptability. He shall permit the representative to examine the transformers at all times from the beginning of their manufacture. The results of all tests specified herein shall be given by the manufacturer to the purchaser or his representative in the form of a certified report.

13. *Description of Tests.*—The following tests will be made upon all the of transformers :—

(*a*) *Design, Materials, and Workmanship.*—Action upon these features will be based on the requirements of the specifications and observations made while the apparatus is under test.

(*b*) *Core Loss.*—Core loss and exciting current shall be taken cold at approximately 25° C. Core loss shall be measured with a wattmeter at normal frequency and voltage, using power from a generator giving a sine wave, when such is available. When a pure sine wave is not available it shall be permissible to use any wave form which comes within the A.I.E.E. definition of a sine wave, adjusting the test voltage so that the core loss will be the same as with normal voltage and sine wave. Where voltage cannot be regulated by excitation of the generator it must be done with auto-transformers and not by rheostats in series with the transformer to be tested. The average of the core losses of the full number of transformers of the same size on one order shall not exceed the value stated in the proposal, and the maximum core loss must in no case exceed this value by more than 10%.

(*c*) *Exciting Current.*—The exciting current, as observed during the test for core loss shall in no case exceed 10% of the full load current, and for transformers of 10 kw. or larger, shall not exceed 8% of full load current. With an applied voltage 10% above normal the exciting current shall not exceed 20% of the full load current.

(*d*) *Copper Loss.*—The copper loss shall be determined by separate measurements of primary and secondary resistance at or corrected to 25° C. The average copper loss of the full number of transformers of the same size on one order shall not exceed the value of copper loss given for that size in the proposal, and the maximum copper loss must in no case exceed this value by more than 10%.

(*e*) *Regulation.*—The regulation shall be computed from the measured resistances and the reactive drop of voltage, using the following expressions.

For unity power factor :—

$$\text{Per cent. regulation} = \frac{100\ I\ R}{E} \qquad (1)$$

For 60% power factor :—

$$\text{Per cent. regulation} = 100\ \frac{0{\cdot}6\ I\ R + 0{\cdot}8\ P}{E} \qquad (2)$$

where E is the rated primary voltage, P the reactive drop of voltage, I the full load primary current (not including exciting current). The equivalent resistance, R, of primary and secondary combined, is found by multiplying the secondary resistance by the square of the ratio of turns and adding to the primary resistance.

The impedance voltage, e, is found by short-circuiting the secondary winding, and measuring the voltage necessary to send full-load current through the primary. The reactive drop is then computed from the expression

$$P = \sqrt{e^2 - I^2R^2} \qquad (3)$$

The per cent. regulation computed in this way shall not exceed the values given in Table I. Under conditions of maximum unbalancing, that is, with full-load current on one side and no load upon the other side, the difference in voltage shall not exceed the stated per cent. regulation.

(*f*) *Heating.*—The two transformers of each size whose combined core and copper losses come nearest to the values stated in the proposal shall be selected for a heating test of that type and size. They may be overloaded and overexcited to hasten the rise of temperature to the ultimate value under constant full load, and the final temperature in any part, maintained for one hour under constant full load and normal voltage and frequency, shall not exceed the temperature of the room (corrected to 25° C.) by more than 50° C. The rise of temperature shall be determined by the increase of resistance of the windings and by thermometer in the oil, placed as directed by the representative of the purchaser, and the highest indicated temperature shall be taken to determine the rise.

If the test be not made with sine wave and rated frequency, the applied voltage shall be adjusted to make the core loss the same as when operating on sine wave of normal voltage and frequency. The load current in amperes shall be based upon rated volts and watts.

The transformers may be loaded with a noninductive load, or they may be subjected to loading conditions by the opposition method.

The rise of temperature of other transformers of the same size and type shall be computed from the sum of core and hot copper losses on the assumption that the temperature rise is proportional to the combined losses. The hot copper loss shall be computed on the assumption of a proportional increase over the cold copper loss, equal to the average proportional increase in the two transformers subjected to heating test.

Any transformer in which the computed temperature rise exceeds the above limits shall be rejected, or, at the option of the manufacturer, subjected to an actual heating test.

(*g*) *Insulation.*—The transformers shall withstand for one minute an alternating electromotive force of 10,000 volts, 60 cycles, between primary coil and wire, case and secondary coil, and 4,000 volts between secondary coil and core and case. Transformers shall also withstand for one minute twice the rated voltage applied to the primary coil. These tests are to be made before oil has been put in the cases.

At the end of the heating run the insulation tests shall be repeated upon the two hot transformers while filled with oil.

Manufacturers' Facilities.

14. The manufacturer shall provide complete and suitable equipment for making tests, which shall include the following :—

(*a*) A source of supply of approximately sine wave and rated frequency.

(*b*) Means for tracing wave forms or determining the correction necessary in order to get sine wave results.

(*c*) Means for determining the frequency, by tachometer connected to the generator, or by frequency meter of the vibrating reed type.

(*d*) Calibrated instruments of suitable capacity for measuring watts, volts and amperes.

(*e*) Apparatus for accurate measurement of resistance, preferably by the drop of potential method.

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(*f*) Apparatus for high-potential insulation tests, including spark gap for measurement of applied voltage.

(*g*) Facilities for flash-point, evaporation, dielectric strength and cold tests of transformer oil.

(*h*) Suitable means for loading transformers by opposition, or else water rheostats or lamp banks for direct non-inductive loading.

BASIS FOR COMPARING GUARANTEES.

15. In case the proposals offered by different bidders in accordance with these specifications guarantee core losses less than those specified in Table I., each watt of difference shall be evaluated at $0.88 for purposes of comparison. For the same purpose copper loss shall be evaluated at $0.33 per watt for each watt difference between values specified in Table I. and the full-load value guaranteed by the bidder.

REJECTION OPTIONAL.

16. In case transformers submitted under these specifications show upon test average core or copper losses in excess of those stated in the proposal, the purchaser shall have the option of accepting them at a reduction from the price bid, the reduction to be determined by making the same allowance per watt for the excess loss as specified under section 15.

TABLE No. I.

MAXIMUM CORE AND COPPER LOSSES.

Rating in Kilowatts.	Core Loss in Watts.	Copper Loss in Watts at Full Load.	Per Cent. Regulation. Power Factor = 1·00.	Power Factor = 0·60.
1	21	26	2·6	3·1
1·5	26	36	2·5	3·1
2	30	46	2·4	3·1
2·5	33	55	2·3	3·1
3	36	64	2·2	3·1
4	41	80	2·1	3·2
5	45	93	2·0	3·2
7·5	64	125	1·9	3·2
10	82	160	1·7	3·2
15	110	216	1·6	3·2
20	135	280	1·5	3·2
25	160	323	1·4	3·2
30	175	374	1·3	3·2
40	210	470	1·2	3·2
50	255	580	1·2	3·3
75	400	875	1·1	3·3
100	560	1000	1·0	3·4

STORAGE BATTERIES IN CENTRAL STATIONS.

By R. Werkner.

We have on more than one occasion referred to the immense services an adequate battery of accumulators is able to render Central Station economics, and the following paper by a German authority puts some of these points very concisely.

Operating expenses can always be more or less lowered by the use of storage batteries and their relation to the different systems of generation and distribution will be discussed. In alternating-current work the three-phase system only is treated, leaving out of consideration steadiness of operation, overload capacity, etc. Operating expenses may be divided in the following items: (1) Interest and depreciation; (2) Fuel; (3) Wages; (4) Maintenance; (5) Oil, waste and small supplies.

DIRECT-CURRENT GENERATION AND DISTRIBUTION.—In a direct-current central station furnishing light and power the introduction of storage batteries allows of cutting the daily machinery run from 24 to 10 or 12 hours. It must be noted, though, that the author considers direct-current only suitable for small central stations, where the storage battery takes up the peak and the total minimum night and day loads.

First Cost of Installation.—If the load on the battery is not very heavy, so as not to require a large storage capacity, and lasts only for a short period of time, the installation cost of a storage battery is lower than the installation cost of a corresponding capacity in boilers, engines, and dynamos. But if the load diagram is such that it would be necessary to have a storage battery of a very large capacity, then the first cost with battery is larger than the first cost without.

Operating Expenses.—(1) Interest and depreciation. Manufacturers guarantee a storage battery for a 20 years' life, which, with an interest tax of 5%, gives a depreciation rate of about 8% per year on the supplementary first cost of installation. In the cases where the central station first cost is larger with battery than without battery, 8% on this difference does not amount to a sum worth considering. (2) Fuel. By a rough calculation the author shows a 34% economy in fuel for the station with a storage battery. (3) Wages. The cutting down of the length of run of the generating machinery enables the cutting down by half of the pay-roll. (4) Maintenance. The cost of maintenance is proportional to the length of run and to the size of the generating machinery, consequently it is less for a small machine running 10 or 12 hours per day than for a large machine running 24 hours. But the maintenance cost of a storage battery is greater than this difference in the machinery maintenance cost, which makes the total maintenance cost larger for the central station with battery than for the one without.

(5) Oil, waste, etc. The economy on this kind of material may in a small installation make up for the larger maintenance cost of a storage battery, so as to leave the economy in fuel and wages totally clear. The same may be said for large installations, and it is safe to consider the installation of a storage battery a good economic policy.

ALTERNATING-CURRENT GENERATION AND DISTRIBUTION.—Comparing the operating expenses of an alternating-current central station with a direct-current station without battery, it may be said *a priori* that the annual expenses for wages, maintenance, lubricating materials and waste are equal in the two cases. In regard to the fuel cost it may be said that the energy losses when working 24 hours per day are also equal in two cases. The energy losses in the customers' distribution systems are also equal and the losses in the primary distribution system are some per cent. lower in the alternating-current high tension lines than in the direct-current transmission lines.

But for the alternating-current central station transformer losses must be added. For a maximum load utilization of the station for a period of 900 hours per year those losses amount to about 36% of the total annual output. They may be decreased by increasing the total time of maximum load utilization by disconnecting those transformers which are not actually in service, and by using a few large transformers instead of many small ones. This loss percentage is consequently smaller in stations furnishing energy for light, power and traction, than in stations which only take care of a lighting system.

If, instead of effecting the distribution by means of individual transformers, a secondary system of distribution is used and all the transformers are connected in parallel, then the transformers can be designed not for the total output but for the average output and transformer losses are decreased. In Germany, from statistics, the transformer losses amount in the average to from 15 to 20% of the total annual output.

From the preceding, fuel expenses in an alternating-current station are larger than in a direct-current station without battery, while the other operating expenses are equal. Moreover, as the installation of a storage battery in a direct-current station will cut down the total operating expense, a direct-current storage battery station is from the operating cost point of view far superior to an alternating-current station. Consequently, with equal cost of installation and equal annual charges for interest and depreciation, a direct-current storage battery is superior to an alternating-current station.

Lately, the introduction of metallic filament incandescent lamps has temporarily given an advantage of current economy to the alternating-current station, as those lamps could more easily be used for low tension alternating currents than for the customary tension of 220 volts direct. But good lamps for 220 volts have been obtained and this advantage tends to disappear.

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THREE-PHASE ALTERNATING-CURRENT STATION.—Would it be of advantage to add a storage battery to an alternating-current central station to cut the running time to 10 or 12 hours per day and have the battery take care of the peak and night and day minimum loads while the central station would only furnish three-phase current to the distributing system?

In the simplest case the installation cost in comparison to the one of a direct-current station is increased by the converting apparatus and the operating expenses are larger on account of larger fuel cost resulting from the energy losses in the double transformation. As the efficiency of a motor-generator set is at variable load about 85%, the battery gives back to the system only about 54% of the total energy that it takes from the generating system for its charging, and if the battery is supposed to furnish 30% of the total output then 55% of the total consumption is used for the charge and the battery losses reach 25% of the total useful power.

From the same fuel calculations that he follows in the direct-current case, the author finds for a storage battery in a three-phase central station a fuel economy of 26%, which is 8% lower than in the direct-current case, due to the converter losses.

The total operating economy would then be a little lower than in a direct-current station, but it would probably reach a not indifferent amount. This total may be still increased by the use of rotary converters which have a higher operating efficiency than motor-generator sets, or by directly connecting to the engine and alternating-current generator a direct-current dynamo which would, during the day, charge the battery, using the excess steam power at low load, and at maximum load periods would (run by the battery as a motor) help the engine in taking care of the alternating-current generator load. In this case the transformation losses are cut by half.

Although for a running time of ten hours storage batteries are economical, when there is no day load those economies in operation obtained by the employment of batteries disappear, and the battery as a substitute to running machinery cannot be used when there is a power load. A 12-hour machinery run is not possible in large towns where the day load is heavy. The battery would then have to be of too large a capacity, and the installation cost, interest, depreciation and maintenance charges would be considerably increased.

In such a case it is better policy to design the central station for a continuous day run and limit the battery to peak-load service.

Generally the load factor is, on a 24-hour service, for a direct-current station 42% and for an alternating station 46%, which gives a comparative increase of 10% in the required capacity to take care of converter losses.

With an all-day service, at uniform load, the installation cost and the interest, depreciation and maintenance charges are smaller than they are in a station designed for a 12-hour run. Salaries, oil, waste, etc., are larger and the amount of fuel used is just about the same, but to render the station profitable the output must be kept as high as possible, and all of it must be sold.

The equilibrium of load which a battery in a direct-current station allows, assures an increase in profits.

In a three-phase station the use of storage batteries is very restricted. A fuel economy will result if in their use the energy losses due to converting apparatus and battery will be smaller than the losses of machinery running at no load. Such is the case when only one machine of total load capacity is used. When two machines are used an economy will be realized by the installation of a storage battery only when the day load is such that one machine is not enough and two run under unfavourable load conditions. The battery then re-establishes favourable load conditions, and as, from three-phase central station statistics, it has been found that in summer the generation of a kilowatt-hour may require 50% more coal than in winter, on account of load difference in the two systems, then the battery used in connection with one machine for summer output may at the end of the year show a large fuel economy. A battery may also be useful in a central station where two machines can care for the average load, and the peak is only slightly larger than the total machinery capacity, for a third machine would be wasteful. Hence in many cases a storage battery is also useful in three-phase stations.

ALTERNATING-CURRENT GENERATION AND DIRECT-CURRENT DISTRIBUTION.—In large cities an alternating-current central station combined with rotary-converter sub-stations is common. The storage batteries are distributed in the sub-stations and operated in parallel with the converters. Then the high-tension transmission system can be designed to take care only of the average load as the batteries take care of the peak and minimum light loads. To decrease the cost of installation of the direct-current transmission lines, highly charged balancing storage batteries are installed in secondary distributing centres. The direct-current cables then only carry the sub-station average load and not the maximum.

Cost of Installation.—The central station generating machinery and the sub-station converters can be of a smaller capacity The cost of the alternating-current and direct-current transmission lines is smaller.

Operating Expenses.—Interest and depreciation charges are decreased. The amount of savings on other operating expenses is equal to the one obtained in a simple direct-current system with storage batteries.

Comparing this system with a purely three-phase alternating-current system without battery it can be seen that the first, on account of the introduction of the sub-stations, has a larger item of cost for maintenance and wages, while the fuel cost is less as the central is operated under favourable load conditions and there are no transformation losses. The system is to be favoured in towns where fuel expenses are a more important factor than wages and maintenance.

PERSONAL.

Changes have recently been made in the United River Plate Telephone Company. Mr. J. E. Parker remains as General Manager in the River Plate, Mr. S. G. Angel has been appointed Secretary to the Local Board, and Mr. C. W. Gwyther, M.I.E.E., has been appointed Manager for Buenos Aires. Mr. Gwyther joined the United Telephone Company of London in 1884, and was appointed manager of the North Wales District for the National Telephone Company in 1893, and manager in Dublin in 1895. In 1900 was engaged by the United River Plate Telephone Company as engineer, for the construction of the underground system, being appointed chief engineer in 1903 and sub-manager in 1906.

Mr. John Young, the first manager of the Glasgow Tramway Department, and subsequently general manager of the Metropolitan District Railway (of which he now is a director), has purchased the estate of Fisherton de la Mere, in the Dylye Valley, near Salisbury, which has an area of 1,700 acres, together with an attractive manorial residence. Mr. Young is a director of the Paisley Tramway Company, and is also interested in other electrical undertakings.

Mr. W. Perren Maycock, M.I.E.E., has recently completed an 18 months' engagement with the International Correspondence Schools, Kingsway, London, and is resuming his consulting and literary work. For some time Mr. Maycock has been engaged upon a new and entirely re-written edition of his "Electric Wiring, Fittings, Switches and Lamps," which book, together with a smaller one dealing with a kindred subject, will be published by Messrs. Whittaker & Company, sometime before the end of the year.

Mr. C. A. B. PYNE (late of Messrs. Balmer, Lawrie & Company, Calcutta) and Mr. E. M. Hughman (12 years with Messrs. Robert Hammond & Son, consulting engineers, Westminster, and late of the County of London Electric Supply Company, Ltd.) have entered into partnership as electrical engineers and contractors under the style of Pyne, Hughman & Company. Mr. Archibald Gall (late of Messrs. James Hodgkinson, Ltd., Manchester, and formerly of Messrs. Andrew Yule & Company, Calcutta) has joined the staff as chief engineer. The headquarters of the firm are in Calcutta, and the London office is at 95, Leadenhall-street, E.C.

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THE
ELECTRICAL ENGINEER.

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IMPORTANT NOTICE TO ADVERTISERS.

Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m. on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements 24 words 1s per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

Situations Vacant, 24 words 1s., three insertions 2s. 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being under taken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

TO SUBSCRIBERS.

THE ELECTRICAL ENGINEER *can be had by order from any Newsagent in Town or Country, and at the various Railway Stations; or it can, if preferred, be supplied direct from the Office on the following terms:*

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United Kingdom ..	3s. 3d. ..	6s. 6d. ..	13s. 0d.
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Cheques, Post Office and Postal Orders for Subscription and Advertisements should be made payable to "THE ELECTRICAL ENGINEER," LIMITED, 149, *Fleet Street, London, and be crossed.*

Bound volumes of THE ELECTRICAL ENGINEER, *containing half-year's copies, bound in Dark-Blue Cloth, Gold Lettered, price 8s. 6d.*

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ELECTRIFICATION AND LABOUR.

An argument frequently advanced in certain quarters against extension of electrification schemes is that electricity is a labour saver. It is quite true that electrically driven appliances do tend to increase output and reduce labour, but it is invariably found that this is merely a matter of displacement, and that far from a reduction an increased demand for labour follows on electrification, because reduction of cost of production results in further extensions. If we take into consideration mining operations in England, Scotland and Wales, we find that no shortage of work has followed the use of electricity in collieries for pumping, winding, hauling and for winning coal. On the contrary the better economic conditions introduced have stimulated the demand for labour. As a matter of fact, the same results can be seen as regards mill electrification. It may be argued that this question of reduction of demand for labour is not one that need concern the electrical engineer, whose duty it is to work as economically as possible. But this is to take a very narrow view. The ultimate benefit of industry as a whole, and this, of course, means a prosperous labouring class, must be the aim. Even if we take the narrow view, however, it will be seen that this question of displacement of labour is a vital one. Progress must necessarily be retarded unless the workers themselves are, as a body, in favour of any special form of advance. These problems, for instance, have played, and are still playing, a great part in the electrification of the Rand mines. The argument has again and again been advanced that the introduction of electricity in South African mines meant loss of employment for a large percentage of skilled white labour. This is especially true as regards the white staff on the surface, in charge of winding and such-like operations. The Power Commission, who investigated this among other matters, declared emphatically that a larger employment of electricity in South Africa would tend to employment of a greater number of white men, because intelligent and skilled workers would be needed for the machinery brought into use. Mr. J. H. Vaughan, in delivering his inaugural address as President of

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SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

the Transvaal Institute of Mechanical Engineers, a few weeks ago, expressed the same views. He bore witness to the steadily increasing influence of electrical power and electrical appliances on the work of both mechanical and mining engineers. This influence is bound to grow, and he was apparently anxious to remove any prejudice in the minds of those whom he was addressing directly and to the much larger audience outside. He was quite clear that the adoption of electricity was to the benefit of all. As pointing to the inevitableness of the increased employment of whites, Mr. Vaughan quoted statistics from the Simmer Pan Station, where the ratio of whites to blacks is 1 to 1, while it is anticipated it will soon reach 2 to 1. With the better financial results obtained new mines will be opened up, and then electricity will be brought to bear to improve haulage, which will mean need for more white men. The change over from steam to electrical winding ought not to entail even displacement to any appreciable degree, for the mechanics now in charge could soon qualify themselves to take charge of the electrical appliances. Mr. Vaughan was at some pains to show that electrification in South Africa has been steadily gaining ground, slowly at first, but more surely now. This slow introduction has been beneficial in preparing everybody for the change. Hitherto, any white labour displaced has been soon absorbed. Now the chances of this change of occupation are all the greater, because the mechanics have had time to adjust themselves to the new order of things. It is well that this aspect of the change should be grasped generally, for Mr. Vaughan, like other competent authorities out there, sees in cheapening of electric power a means to a great and steady development, not only in mining but in other branches of industry. This confirms the remarks we put forward in a recent leading article, when we pointed out the big field for British electrical manufacturing engineers that is springing up in South Africa. The very fact that the Presidential address at the Institute of Mechanical Engineers should be practically devoted to a review of the electrical position, past, present and to come, is significant. With white labour convinced of the inevitableness and benefits of electrification, progress will be all the more rapid.

FINANCIAL NOTES.

WASTE HEAT AND GAS ELECTRICAL GENERATING.—The directors of the Waste Heat and Gas Electrical Generating Stations have declared an interim dividend at the rate of 5% per annum, free of income tax, in respect of the half-year ending July 31, 1910.

* * *

SILVERTON TRAMWAY.—The directors of the Silverton Tramway Company, Ltd., have declared an interim dividend of 1s. per share, plus a bonus of 1s. per share.

* * *

MATHER AND PLATT.—The directors have declared an interim dividend on the Ordinary shares of 5%, free of income tax, for the half-year ended June 30, 1910, being at the rate of 10% per annum.

* * *

W. T. HENLEY'S TELEGRAPH WORKS.—The directors have declared an interim dividend on the Preference shares at the rate of 4½% per annum, less income tax, and on the Ordinary shares at the rate of 10% per annum, free of income tax, for the half-year ending June 30 last, both payable September 1.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

TO MANUFACTURERS OF ELECTRICAL ACCESSORIES.

The Commissioners of H.M. Works and Public Buildings are prepared to receive TENDERS for the SUPPLY of ELECTRICAL ACCESSORIES for the period from September 1, 1910, to August 31, 1911. Particulars of the samples and estimated quantities required and a copy of the conditions and form of Tender may be obtained on application to the Storekeeper, H.M. Office of Works, Engineers' Stores, 20, Newington-butts, S.E.

The Commissioners do not bind themselves to accept the lowest or any tender.

Tenders must be delivered before eleven o'clock a.m. on Wednesday, August 24, 1910, addressed to the Secretary, H.M. Office of Works, etc., Storey's-gate, London, S.W., and endorsed "Tender for Electrical Accessories."

H.M. Office of Works, etc., August 10, 1910.

TENDERS FOR INSTALLATION OF WIRELESS TELEGRAPHY within the DOMINION of NEW ZEALAND.

General Post Office,
Wellington, May 23, 1910.

Tenders indorsed "Tender for Installation of Wireless Telegraphy within the Dominion of New Zealand" will be received by the Minister of Telegraphs, General Post Office, Wellington, up to noon of December 15, 1910, for the supply and erection at the following places of installations of wireless telegraphy in accordance with Specification and General Conditions:—

(1.) At or near Doubtless Bay.
(2.) At or near Gisborne.
(3.) At or near Cape Farewell.
(4.) At or near Sumner, near Christchurch.
(5.) At or near Bluff.

Specification and General Conditions and "Form of Tender" may be obtained at the office of the Superintendent of Electric Lines, General Post Office, Wellington; the office of the High Commissioner, 13 Victoria-street, London; and also from

(1.) Messrs. R. W. Cameron & Company, 23, South William-street, New York, U.S.A.;
(2.) H. Stephenson Smith, Esq., 244, California-street, San Francisco, Cal.

Tenders must be made out on the "Form of Tender," and must be accompanied by a deposit or receipt for a deposit as required by the General Conditions.

Deposits on tenders must accompany the tenders in the form of a bank draft, or the deposit may be banked. The banker's certificate must be forwarded with the tender, but it must be approved by the High Commissioner, London; or by

(1.) Messrs. R. W. Cameron & Company, 23, South William-street, New York, U.S.A.; or by
(2.) H. Stephenson Smith, Esq., 244, California-street, San Francisco, Cal.;

and must be to the effect that the amount of the deposit is held at the call of the Minister of Telegraphs.

Tenderers must state the name of the country in which the apparatus, etc., will be manufactured.

The Minister of Telegraphs does not bind himself to accept the lowest or any tender.

Tenders must be addressed to the Minister of Telegraphs, General Post Office, Wellington, New Zealand. If sent by post they must be prepaid and be registered.

J. K. LOGAN,
Superintendent of Electric Lines.

APPOINTMENTS.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

ASSISTANT EXAMINERS IN THE PATENT OFFICE (20-25). *September 1st.*

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the Secretary,

CIVIL SERVICE COMMISSION,
Burlington Gardens,
London, W.

CONTRACTS OPEN.

HOME.

BOURNEMOUTH.—Corporation invite tenders for the supply of 450 tons tramway rails with fastenings. (Specifications, etc. (deposit £2), Mr. C. W. Hill, Tramways Manager.) August 31.

BOURNEMOUTH.—Corporation invite tenders for the reconstruction of 2½ miles tramways permanent way. (Specifications, etc. (deposit £2), Mr. C. W. Hill, Tramways Manager.) August 31.

CHELMSFORD.—Borough Education Committee invite alternative tenders for (1) supplying and fixing wiring for lighting by electricity; (2) supplying and fixing pipes for lighting by gas, at the Trinity-road Council School. (Particulars from Mr. W. H. Pertwee, architect, The Institute, London-road, Chelmsford.) August 31.

COLCHESTER.—Corporation invite tenders for the supply of about, 5,000 tons of rough nutty slack coal at the Electricity Works, during the year commencing October 1. Forms, etc., from the Electrical Engineer. August 29.

IPSWICH.—Corporation.—Annual supply of underground cables. (Specifications, £1 1s., Chief Engineer and Manager, Electric Supply Department). August 22.

KETTERING.—Urban District Council.—Three steel chain independent boiler elevators (one ton of coal per hour each). (Specifications, Electrical Engineer). August 22.

KIRKCALDY.—Corporation invite tenders for material for one mile of 3 ft. 6 in. gauge single line with four passing places as follows:—No. 1, Permanent way construction; No. 2, Steel poles and brackets for overhead construction; No. 3, Three section pillars with fittings complete; No. 4, Trolley wire and overhead line material. (Nos. 2, 3 and 4, supply and delivery only.) (Specifications, No. 1, Burgh Surveyor, Tolbooth-street; Nos. 2, 3 and 4, Burgh Electrical Engineer, at works.) August 29.

LONDON.—H.M. Office of Works invite tenders for the supply of electrical accessories for the period from September 1, 1910, to August 31, 1911. Particulars from the Storekeeper, H.M. Office of Works, 20 Newington Butts, S.E. August 24.

LONDON.—The County Council invite tenders for the wiring and fitting for electric lighting of the second portion of the central car repair depôt, Woolwich-road. Particulars (40s.) from the Clerk of the Council, County Hall, Spring-gardens, S.W. This amount will only be returned if a *bona-fide* tender is submitted. August 30.

LONDON.—The County Council invite tenders for the covering with asbestos tape of certain electric cables of the Council in manholes in the south of London. Specifications (40s. deposit), Clerk of the Council, County Hall, Spring-gardens, S.W. August 30.

LONDON, S.W.—London County Council.—Wiring and fitting second section of Woolwich-road car repair depôt. (Specifications £2, County Hall, Spring-gardens, S.W.) August 22.

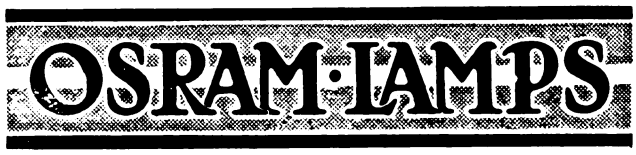
RAINHILL.—The Lancashire Asylums Board invite tenders for supply and delivery of telephone apparatus and cable, consisting of main central battery system, metallic circuits and telephone switchboard complete. (Particulars from the Clerk, Rainhill Asylum, Lancs.) August 25.

ST. ANNE'S-ON-SEA.—The Urban Council invite tenders for the supply of slack to the Electricity Works. Particulars from the Electrical Engineer. August 22.

OVERSEAS.

CAIRO.—Public Works Department.—Electrical installations at Khanka Lunatic Asylum. (Particulars, Service Administratif Ministree des Travaux Publics.) October 20.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hopital des aliéoés, à Khanka," will be received, up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to



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PATENTS.

S. SOKAL, Chartered Patent Agent,
AND
Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.
55, CHANCERY LANE, LONDON, W.C.

THE OWNER OF BRITISH PATENT No. 19462, of 1906 entitled "Improvements in Destination Indicators for Tramway Cars," granted to L. J. Hunter, is desirous of disposing of the patent or entering into a working arrangement under license with firms likely to be interested in the same. In the alternative, the owner would be open to consider proposals to manufacture the invention to fill any requirements of the market in Great Britain on terms to be arranged.

The patent covers an invention interesting to manufacturers of Destination Indicators for use upon tramway cars.

Detailed information as to the invention will be found in the patent specification, of which a copy will be supplied to any interested party on request.

Full particulars can be obtained from and offers made (for transmission to the owner) to—MARKS & CLERK, 57 and 58, Lincoln's Inn Fields, London, W.C.

THE PROPRIETOR OF THE PATENT NO. 29363 of 1904, for "Improvements in and relating to Electrical Measuring Instruments," is desirous of entering into arrangements by way of license and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to HASELTINE, LAKE & COMPANY, Chartered Patent Agents and Consulting Engineers, 7 and 8, Southampton-buildings, Chancery-lane, London, W.C.

THE PROPRETOR of LETTERS PATENT No. 23491 of 1902 relating to "Magnetic Wheels," desires to dispose of the Patent or to grant licences to interested parties on reasonable terms with a view to the adequate working of the Patent in this country.—Enquiries to be addressed to CRUIKSHANK & FAIRWEATHER, Ltd., International Patent Agency, 65-66, Chancery-lane, London, W.C.

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APPLICATIONS for Appointments effectively arranged, ensuring favourable consideration. Numerous unsolicited testimonials. Expert advice. Write now.—HERBERT GREATOREX, Beechwood, Matlock.

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FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, seeks apprenticeship with Electrical Engineer. Intelligent, good education.—S.A., c/o ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

A CAPABLE ELECTRICAL ENGINEER, shortly disengaged. Home and Colonial experience, stationary or erecting, C. I., New Rock Colliery, Stratton-on-Fosse, near Bath.

MISCELLANEOUS.

CLEANERS and BLEACHERS of Meat Cloths for Engineers' and Garage use, sold in 7 lbs. bundles at 3/6, cash with orders. Carriage forward.—A. & T. INGERSOLL, 62, Waterloo-street, Camberwell, London, S.E.

EVERY ARC LAMP USER in the kingdom should read "The Application of Arc Lamps to Practical Purposes," by Justus Eck, M.I.E.E. The best book on the subject ever issued. Clearly written and well illustrated. Practically it is the "Arc Lamp Users' Manual." Cloth 8vo. 2s. 9d. net, post free, from RENTELL, Publishers, London.

be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. (Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels.) September 26.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). (Specifications, Direction des Chemins de Fer d'Outre-mer, Lisbon.) October 12.

LORENZO MARQUES.—Harbour and Railways Board.—One 10-ton and 75-ton electric cranes. (Particulars, 9 milreis gold, General Stores, Harbour and Railway Board, Lorenzo Marques, or Agency of Caminhos de Ferro de Lorenzo Marques, Johannesburg, or Direcçao dos Caminhos de Ferro Ultramarinos, Lisbon.) English translation, 4·5 milreis gold, from Caixa Geral dos Depositos, Lisbon, or from the Johannesburg or Lorenzo Marques authorities above indicated. September 5.

MELBOURNE.—H.M. Trade Commissioner for Australia (Mr. C. Hamilton Wickes) reports that tenders will be received, up to 3 p.m. on September 20, at the office of the Deputy Postmaster-General, Melbourne, for the supply of telegraph and telephone material (Schedule No. 308). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. A copy of the specification, etc., may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

TENDERS ACCEPTED.

HOME.

HORNSEY.—The tenders of Messrs. Alfred Blackmore & Company, for the supply of 1,500 to 2,000 tons of West Hallam or Mapperley nutty slack, and that of Herbert Clarke, Ltd., for the supply of 1,000 tons of wharf nutty slack, were accepted.

WHITEHAVEN.—Electricity Works. 1910 Extensions.—List of accepted contracts: New boiler, superheater and mechanical stoker, Babcock & Wilcox; fuel economiser, E. Green & Son, Ltd., per Vulcan Engineering Company, Ltd.; Whitehaven, boilerhouse pipework, Stout & Sons, Newtown Foundry, Whitehaven; main switchboard, Whipp & Bourne, Castleton, near Manchester; 250 kw. steam generator, Browett Lindley & Company, Patricroft, Manchester; with dynamo by Phœnix Dynamo Company, Bradford; bitumen cables, Callenders Cable & Construction Company; mechanical stokers for existing boilers, Ed. Bennis & Company, Bolton; superheaters for existing boilers, Babcock & Wilcox, Ltd.; boiler house runway, E. Vaughan & Son, West Gorton, Manchester; motor converter, The Electric Construction Company, Wolverhampton.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so:—

BASINGSTOKE: A second County Asylum is to be built on Brewelt Farm for the Hampshire County Council and the County Boroughs of Bournemouth and Southampton. Accommodation 1,300 patients.

BRISTOL: Post-Master, or H.M. Office of Works, Westminster. New Post-office.

DUBLIN: H. Williams, secretary, Office of Public Works, Dublin. Clothes stores at Royal Irish Constabulary Depôt, Phœnix Park.

DUBLIN: W. H. Byrne & Son, architect, 20, Suffolk-street, Dublin. Nursing home for St. Vincent's Hospital.

FELIXSTOWE: H. Clegg, Municipal Engineer, Town Hall. Isolation Hospital, with administration, disinfecting, and laundry block.

GLOUCESTER: W. B. Wood, architect, 12, Queen's-street, Gloucester. Additions to Sir Thomas Rich's school.

GRIMSBY: Rev. F. M. Blakiston, St. John's Vicarage, Grimsby. Alterations and additions to St. John's Assembly Rooms.

LONDON: E. C. Verity, surveyor, 7, Great Marlborough-street, W. Block of buildings in Portland-street.

RUISLIP: The Garden Estates, Ltd., are about to lay out an estate of 1,300 acres at Ruislip and Northwood as a garden suburb. Address, Garden Estates, Ltd., 33, Henrietta-street, London, W.C.

SOUTHEND-ON-SEA: Percy Brockbank, architect, County-chambers, Weston-road. Westborough Council School, for 1,200 children.

STIRLING: Town Clerk. New Municipal buildings.

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The Latest and Most Novel Patterns.

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12, Lime St., LONDON, E.C.

PLANT WANTED.

PLATINUM UTENSILS, SCRAP, LAMP TOPS.—Best prices given by DERBY AND CO., LTD., 44, Clerkenwell-Road, London, E.C. N.B.—Platinum Sold.

PLATINUM WIRE FOILS, lamp ends and scrap. Old gold, silver and mercury purchased at highest prices, by—THE LONDON REFINING & METALLURGICAL WORKS, 32, Clerkenwell-road, London, E.C. Telephone: Holborn 388.

PLANT FOR SALE.

Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

FOR SALE, E.C.C. Dynamo, 135 amperes, 165 volts, in first-class order, £25; complete Switchboard for same, £7. Two 20 h.p. Alternating Current Motors, by General Electric Co., 200 volts, 50 periods, three-phase, complete £20 each.—JAMES TAYLOR, Riverside Works, Staines.

NORTHAMPTON ELECTRIC LIGHT AND POWER.—The directors of the Northampton Electric Light and Power Company, Ltd., have decided to pay a half-year's dividend at the rate of 5% per annum on the Preference shares, and an interim dividend at the same rate on the Ordinary shares, for the half-year ending June 30. The interim dividend paid on the Ordinary shares for the corresponding period of 1909 was at the rate of 4½% per annum.

NOTES.

Small Power Motors and Generators.

The British Thomson-Houston Company, Ltd., have issued a handsomely illustrated 12-paged price-list of their DG type of motors and generators, giving full particulars. These motors are made in various patterns: "protected," with expanded metal covers, with solid covers, and of the enclosed ventilated description. This last is a most serviceable machine. It is dust-proof and has a flange fitted to the motor for connection to an air duct, through which a supply of clear air can be drawn. The standard position of the intake flange is at the bottom of the end shield, but if required it can be arranged for top connection. Motors of this type are particularly suited for tool driving, where small chips of metal are liable to drop into the motor, or for other services in exposed positions where rain may drive into the motor. Also for paint mixing machines, pumps, etc., where the motor would be subject to splashes of paint or water, and for driving woodworking machines, coal hoists, etc., where falling dust is likely to enter the motor.

Siemens' "Onewattlite."

The new development introduced some months ago by Messrs. Siemens Bros. Dynamo Works, Ltd., Tyssen-street, Dalston, London, N.E., when placing their 100 c.p. lamps on the market is now generally known to the trade as the "Onewattlite." Particulars of this have been widely circulated by the above firm, and it is worthy of the consideration of the contractor who is more particularly interested in supplying shopkeepers and trade establishments. It consists of a 100 c.p. "Onewatt" lamp used in conjunction with a suitable design of "genuine" Holophane glass reflector fitted to a gallery, which brings the lamp into true focus and obtains the best possible illumination effects. Holophane glassware is now widely known for its special reflecting capacity and used in conjunction with the "Onewatt" drawn tungsten lamps, provides a cheap and efficient method of illuminating the display windows and interiors of shops. Contractors are specially asked to note that when ordering "Onewattlite" the price quoted is inclusive of glassware, gallery, and 100 c.p. "Onewatt" lamp complete, with the exception of the lamp holder, and is readily fitted to any existing lamp holder which may be installed. In the case of new installations, however, it would be necessary to order lamp holders extra. We state these facts for the guidance of contractors, as during the great demand experienced for the "Onewattlite" there has been some little misunderstandings which have led to delay in delivery. Messrs. Siemens Bros. Dynamo Works, Ltd., will be pleased to supply full particulars of this speciality to all contractors who are particularly interested in this class of work mentioned.

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TECHNICAL CLASSES.

City and Guilds of London Institute.

ENGINEERING AND CHEMISTRY.

There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE.

(EXHIBITION ROAD, S.W.)

A College for higher Technical Instruction for Day Students not under 16 preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a "*School of the University of London*," and also forms the *Engineering Section of the Imperial College of Science and Technology*. The Entrance Examination includes the subjects of Mathematics, Mechanical Drawing, Physics, Chemistry, English Composition, and French or German Translation, and the Courses of Study for the Associateship of the Institute cover a period of three years. Fees, £36 per Session. Professors :—

Civil and Mechanical Engineering ..	W. E. DALBY, M.A., B.Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering	T. MATHER, Wh. Sch., F.R.S.
Chemistry	H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics	O. HENRICI, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY.

(LEONARD STREET, CITY ROAD, E.C.)

A College for Day Students preparing to enter Engineering and Chemical Industries, and for those who have already served an apprenticeship, and also for Evening Students. The subjects of the Entrance Examination are Mathematics, and English Composition and Precis Writing. The Day Courses in Mechanical or Electrical Engineering cover a period of two years, and those in Chemistry three years. Fees, £20 per Session. Professors :—

Physics and Electrical Engineering	SILVANUS P. THOMPSON, D.Sc. F.R.S., Prin. of the College
Mechanical Engineering and Mathematics ..	E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry	R. MELDOLA, F.R.S., F.I.C.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C.

Northampton Polytechnic Institute,

Clerkenwell, London, E.C.

ENGINEERING AND TECHNICAL OPTICS.

MECHANICAL AND ELECTRICAL ENGINEERING AND ELECTRO-CHEMISTRY.

Full Day Courses in the Theory and Practice of the above Subjects will commence on MONDAY, OCTOBER 3, 1910. The courses in Mechanical Engineering include specialization in Automobile and Aeronautical Engineering, and those in Electrical Engineering include specialization in Radio-Telegraphy. ENTRANCE EXAMINATION on WEDNESDAY and THURSDAY, SEPTEMBER 28 and 29. These courses include periods spent in Commercial Workshops, and extend over four years. They also prepare for the degree of B.Sc. in Engineering at the University of London. Fees, £15 or £11 per annum.

THREE ENTRANCE SCHOLARSHIPS of the value of £52 each will be offered for competition at the entrance examination in September next.

TECHNICAL OPTICS.

Full and Part Time Day Courses in all branches of this important department of Applied Science given in specially equipped laboratories and lecture rooms.

Full particulars as to fees, dates, etc., and all information respecting the work of the Institute, can be obtained at the Institute, or on application to

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE, GLASGOW.

SESSION 1910-11.

Day Classes begin TUESDAY, September 27. Evening Classes begin Thursday, September 22.

The DIPLOMA of the College is granted in the following departments:—Civil Engineering, Mechanical Engineering, Electrical Engineering, Mining, Naval Architecture, Chemistry, Metallurgy, Mathematics and Physics, Building, Textile Manufacture.

The Courses of Study for the Diploma usually extend over Three Sessions. The average fee per Session is £12 12s. Holders of the Diploma are eligible for the Degree of B.Sc. in Engineering of the University of Glasgow after attendance for at least one Session upon prescribed University Classes. In conjunction with the Glasgow School of Art a Course for a Joint-Diploma in Architecture has been arranged.

The preliminary examination for Candidates for the Diploma begins on September 19. Names of Candidates must be lodged not later than September 1.

New and well-equipped Laboratories have been provided in the Departments of Physics, Chemistry, Technical Chemistry, Dyeing, Metallurgy, Mechanics, Motive Power Engineering, Electrical Engineering, Mining, Textile Manufacture, Biology, Bacteriology and Navigation, and facilities for research are afforded.

Calendar (price by post, 1s. 4d.) and Prospectus (gratis) will be sent on application to the Secretary.

University of Durham.

Armstrong College, Newcastle-upon-Tyne

PRINCIPAL: W. H. HADOW, M.A., D.MUS.

SESSION 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

Departments of Mechanical, Marine, Civil, and Electrical Engineering, Naval Architecture, Mining, Metallurgy, Agriculture, and of Pure Science, Arts, and Letters.

Full particulars may be obtained on application to—

F. H. PRUEN, M.A.,
Armstrong College, Secretary.
Newcastle-upon-Tyne.

CROYDON CORPORATION TRAMWAYS.

The following official returns of the first year's results from the opening of the London County Council Tramways extension from Streatham to Norbury, and the institution of through bookings between Croydon and London is interesting. The period covered is from July 31, 1909, to July 30, 1910, inclusive :—

NORBURY AND PURLEY ROUTE :			
Miles run	1,058,696		
Passengers carried	10,448,687		
Total receipts	£39,538	13	7
,, increase	£13,831	8	2½
Average weekly increase	£265	19	9
THROUGH BOOKINGS ISSUED :			
By London County Council ..	508,504		
By Croydon Corporation	569,548		
Total issued	1,078,052		
Croydon issue over L.C.C.	61,044		
VALUES :			
By London County Council	£6,025	0	4½
By Croydon Corporation	£7,111	2	2
Total	£13,136	2	6½
Croydon value over L.C.C.	£1,086	1	9½
PROPORTIONS DUE :			
To London County Council ..	£8,948	7	1
To Croydon Corporation	£4,187	15	5½
Total	£13,136	2	6½

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Tramway matters—some of them not altogether agreeable—have exercised the minds of the Tyneside community during the past week. It appears that some time ago, Mr. John Tate, the secretary of the local union of the Tramway Workers Association, made a statement to the men to the effect that corruption was going on in the tramways department. The Tramways Committee thereupon required either proof or a withdrawal of the statement. Mr. Tate wrote a letter which was discussed by the Tramways Committee and certain charges were dealt with point by point. The Committee also wrote to the executive of the Newcastle and District Tramway Workers' Union emphasising their willingness to receive deputations and discuss matters of dispute. Mr. Tate has communicated to the local press a series of letters passing to the Tramways Committee, and makes a lengthy statement. The chairman of the Tramways Committee, on his part, refuses to debate further with Mr. Tate until charges against members are withdrawn. It is, of course, difficult to form a definite balance of opinion as to the merits of this dispute, but in view of the disastrous effect of differences upon transport arrangements, as shown by the late North Eastern Railway strike, it is deplorable that Newcastle-upon-Tyne should be giving the lead to other tramway centres in the direction of industrial dispute. It is to be hoped that any legitimate grievances, if any such exist, may be speedily settled, as the electrical industry does not want any additional burdens to those which if already bears.

Trackless Trolley Proposal for Newcastle.

Of more satisfactory interest is the news that the Newcastle Corporation proposes to promote a Parliamentary Bill having, amongst other objects, the scheme of extending its tramway service to the coast and elsewhere by means of the trackless trolley system. This will probably be the precursor of the ordinary tram-line system at a later date. The crowds which go from Newcastle to Whitley Bay undoubtedly would provide a good paying nucleus for the scheme, and a linking up of the districts around Newcastle would be a material improvement. The route to Whitley Bay and Monkseaton would probably run through Benton, a rapidly developing high-class suburb, while other neighbourhoods such as Blaydon, Newburn, Lemington and the outskirts of Heaton will probably be included in this useful scheme.

Other Tramway Matters.

The Tyneside Tramways and Tramroads Company has just been able to pay 1% on its Ordinary shares in addition to its 5% Preference shares, which, in view of the fact that increased returns on the past six months, as compared with the previous period last year, have been obtained, and that the permanent way and rolling stock have been kept in good repair out of revenue, is distinctly satisfactory in these hard times. At Stockton there is a movement on foot for the extension of the local tramways, Sir J. Clifton Robinson having assured the Stockton Chamber of Commerce that his company was prepared to give the matter their earnest consideration.

An Electrical Exhibition at Sunderland.

We have had a lull in exhibitions in the northern counties for some considerable time, but this is to be remedied in October next by an Electrical Exhibition at Sunderland, which is being promoted by the electrical contractors of the town, and supported by the Corporation. An application has been made by the promoters to the Electricity and Lighting Committee of the Sunderland Corporation for the free supply of electric current or alternatively a donation towards the expenses of the exhibition, on the ground that an increase of business for the electric supply undertaking of the Corporation would be the result. The Committee recommended that a cost not exceeding £50 be incurred by the Corporation for this object. It is to be hoped that Sunderland's enterprise will be a success.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

One of the most interesting papers read at the Convention of the British Foundrymen's Association at Manchester was that by Mr. W. S. Gifford, A.R.S.M., on "The Electric Furnace." The paper was practically restricted to the Héroult tilting furnace, of which some eight are being installed at the present time in England and Wales. Some hundreds of metallurgists, including a number from Birmingham, have been touring the Continent with the object of studying the operations of this furnace. During the discussion, Mr. F. J. Cook, Foundry Manager to Messrs. Belliss & Morcom, of Birmingham, enquired whether the furnace had yet been applied to the smelting of grey iron in the foundry, but no case of the kind had come within the knowledge of the members. Enquiries made in Birmingham suggest that the district is a little backward in applying the furnace to this use. The explanation seems to be that high-class steel, for which it is most useful, is not very largely produced in Birmingham. Its great merit for this purpose is that practically oxygen, the most dreaded element in the eyes of practical metallurgists, can be entirely excluded from the electric furnace, and this enables steel to be produced of extraordinary purity. This is its recommendation to Sheffield, which is probably the most important centre in the world for the production of high-class tool steel.

Electric Smelting of Alloys.

Any number of smelting demonstrations have been given with the electrical crucible at the Municipal Technical School, especially by Mr. J. H. Stansbie, one of the tutors, who is an enthusiast in this class of work. It would seem that there is a sphere for electrical smelting in Birmingham if only for the smelting of copper, and of bronzes, and similar alloys. The exclusion of oxygen is just as important to copper smelters as to the producers of steel, inasmuch as a neutral atmosphere is a most important desideratum. Oxygen is a great destroyer of copper when it gets beyond control. The only objection to the use of electricity is that copper has a melting point of about 980°, whereas carbon steel melts at something like 1,600°, and the furnace could not, therefore, make the fullest use of the electrical power available. This consideration enters very materially into the question of current cost.

Mexican Enterprise.

An interesting experiment was made a short time ago by a syndicate which installed plants at Ocker Hill, near Wednesbury, for the purpose of testing the application of electricity in the smelting of steel. The promoters desired to satisfy themselves before finally deciding to install plant in Mexico for the manufacture of tool steel. The great desideratum was to get a very low proportion of phosphorus, and, although some slight electrical troubles were met with in this particular, the experiments were entirely successful, and it is understood that the Mexican plant will shortly be installed. It is quite likely that even for high-class grey iron castings some use will be found for electrical smelting in Birmingham, since the matter is under consideration by leading local experts. The great attraction of the process is that sulphur can be so reduced as to bring down the iron to crucible quality.

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Large Motor.

One of the largest motors for ironworks purposes ever produced in this country is the one approaching completion at the Dynamo Works of Siemens Bros., Stafford. It will be of 10,000 h.p., weighing nearly 200 tons. It comprises a complete self-contained unit running in two bearings and producing its power at 60 r.p.m. when supplied with current at a pressure of 920 volts direct current. There is an arrangement by which the impressed voltage can be raised to about 1,400 volts, when it will deal with maximum peak loads of 1,500 b.h.p. at 90 r.p.m. The motor has a ventilated commutator at each end. Its total length is 25 ft. and its diameter 12 ft. When complete it will be applied to drive a 36 in. cogging mill and a finishing mill, reducing 2½ ton steel ingots down to rails in one operation without re-heating of the billet. The rapidity of operation enables the heat of the ingot to be retained and the work to be completed at a single operation. Current will be furnished from a 10,000 h.p. motor generator flywheel set on the Ilgner principle, the flywheel being 50 tons in weight and running at 480 r.p.m. Control will be effected entirely on the shunt current, and the armature current of 10,000 amperes will not be handled at all. The operator will be able to reverse the whole of the rolls to full speed either way nearly thirty times per minute, enabling the rail to be produced in four minutes. The gain in speed alone, it is hoped, will increase the output by 20%. Electrical driving of steel mill machinery is rapidly becoming general, but the new plant will be among the best in the world for this purpose.

Domestic and Trade Outlets.

The Birmingham Electric Department is making rapid progress in the application of electricity to what may be called domestic and tradesmen's uses. For example, quite a number of hairdressers in the centre of the city have introduced electricity for the application of revolving hair brushes. The great advantage is that they may be driven directly without the medium of a belt, and this increases the safety of the operations and is popular with the customers. Hairdressers appreciate the electrical application for vibro massage and for hair drying. Some of them make a point of the fact that by means of an electrically driven fan the largest head of hair can be dried either with warm or cold air in five or six minutes. No application of electricity has been more successful. Other uses are for electrical glue pots, soldering irons, tailors' smoothing irons, and for the heating of copper pots and teapots in hotels, etc. An aluminium heating stove, very light and portable, looks like having a very good run.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The fire alarms at Berlin are to be provided with electric alarm lights to replace the gas-lighting system which has proved not only unreliable, but also dangerous, as the gas taps were often opened without being lit.

New Electric Works.

An electric station on a large scale is to be established at Lissberg in Hesse to supply high voltage currents for all purposes to a district extending from Grunberg to Altenstadt in one direction, and from Friedberg to Schotten in the other. The cost will be about £200,000. Shares will be issued bearing the nominal value of £50 each. The province of Oberhessen guarantees a minimum dividend of 3%, and a maximum dividend of 5%. Any excess of receipts above what is required to pay the latter dividend will go to the province for general public purposes.

Mono-rail.

G. Schimpff, writing in the "Elektrische Kraftbetriebe und Bahnen," discusses the technical and economic prospects of the mono-rail gyroscope system. The idea of the mono-rail is to run trains at 120 miles per hour. Schimpff asserts that velocity can be attained on an ordinary railway and argues that the mono-rail must have economic advantages before it can compete with the older systems. The hanging railway must also be considered in this connection as it has certain advantages over both the mono-rail and the ordinary systems. The gyroscope can neutralise oscillation but not shocks. The sharpness of the curves that can be negotiated on the mono-rail is limited by the oblique position of the coaches and the difficulty of accurately adjusted crossing curves. In this latter respect the hanging railway has the advantage over both its competitors. The gyroscope line may have sharper curves than the ordinary line, but still sharper curves are admissible on a hanging railway. It is easy to see that much experience remains to be acquired before the mono-rail will enter into practical politics. For one thing, there are many technical difficulties in the way of current supply.

The Hamburg Telephone Central.

The new building erected by the German Post Office at Hamburg as a telephone central is of imposing dimensions and has considerable architectural merit. The contracts were divided between the Deutsche Telephon Werke of Berlin, the Felten and Guilleaume Lahmeyer Werke the A.E.G., and The Telephonapparat Fabrik E. Zwietusch & Company. The main hall is over 400 ft. long and is designed for 40,000 subscribers. There are already 35,000 and plans are ready for erecting another hall of the same size as it is expected that it will be wanted before very long.

A Miniature Dynamo.

According to the "Elektrochemische Zeitschrift" an electrical engineer named Travet has made the smallest motor in the world. It weighs only a quarter of an ounce avoirdupois, and its outside measurements are about $\frac{2}{3} \times \frac{2}{3} \times \frac{1}{2}$ in. The armature is $\frac{1}{4}$ in. in diameter, and contains 5½ ft. of wire. The current required is one-fifth of an ampere at 3½ volts.

Electric Railways.

The electric railway between St. Polten and Gusswerk is the first European narrow gauge single phase line. The gauge is 30 in. and the line is 55 miles long. The works were difficult as there are no less than 16 tunnels, one a mile and a half long, and 15 short ones, the collective length of which is one mile. The sharpest curve is 100 yards radius and the steepest incline 1 in 40. The current is derived from three separate stations, one of which, however, is kept as a reserve, and supplied to the locomotives from an overhead wire. Each locomotive has two 250 h.p. motors. Each locomotive weighs 30 tons and can take a train weighing 150 tons up a bank of 1 in 40 at a speed of 18 miles per hour.

The International Incandescent Lamp Trust.

There are distinct symptoms that this combine will shortly come to a premature end. The combine was made in 1903 with headquarters in Berlin. It consists of 18 firms including the Siemens and Halske, A.G., the A.E.G., and several other large undertakings. In the last five years the profits of the combine have diminished by one-third, although the output has remained constant at about 30 million lamps a year. The natural increase in the number of lamps made is absorbed by metallic filament lamps, and these lamps will have to be included if the trust is to continue, as was at first intended, until 1914, especially as it is fairly certain that the sale of 30 million cannot be longer maintained, so that a further heavy diminution of profits is imminent.

Electric Ventilation.

Very shortly the electric plant for ventilating the Tauern tunnel will be put into full operation. The system is a new one, devised by an Italian engineer, Saccerdo. The power is derived from 6,000 h.p. turbines driven by water. The current is taken to the tunnel, a distance of three or four miles, by overhead wires. The fans are 18 ft. in diameter and can supply the tunnel with up to 600 cu. ft. of fresh air per second. This ventilating plant is the largest of its kind in Europe, and the first ever erected in Austria.

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Company Notices.

The Felten & Guilleaume Lahmeyer Werke, A.G., of Muhlheim, had a serious falling off in net profits in 1909, viz., from 5,127,520 marks in 1908 to 3,624,035 marks. The capital is practically unchanged and consists of 55 million marks in shares and 25¼ million in Debentures. The dividend has in consequence been reduced from 8% to 6%. The falling off is attributed to increased competition, but the directors are confident of the future, and so are the shareholders, as they passed the accounts at the general meeting unanimously and re-elected the board.

The Hartmann & Braun A.G., of Frankfort-on-Main, has had a similar experience. The net profit fell from 483,895 marks in 1908 to 270,309 in 1909. The dividend on the capital of 1,700,000 marks in shares and about 600,000 in Debentures has dropped from 11% to 8%. Competition with larger businesses is the main cause to which the deficiency is due, but general depression of the trade in electric meters is also a considerable factor. The carry-over for the present year is 23,291 marks, but 1909 had the benefit of 32,396 marks from 1908.

The Hacke Thal Draht und Kabel Werke, A.G., although 1909 was only the third year of its existence, reports an interrupted increase in business. It made up for the reduced rate of profit due to competition by securing an increasing turnover. This required an extension of plant and buildings, wherefore the capital was increased. The net profit for 1909 was 133,845 marks, of which 105,000 went to pay a 7% dividend on the increased capital, 2,050 to remunerate the directors, and 20,795 to provide for the current year.

The Akkumulatoren-Fabrik, A.G., Berlin, reports that use of stationary secondary batteries fell off in 1909, while that of portable batteries on motor vehicles increased. The capital is 8 million marks in shares and 3 millions in Debentures. The net profit was 1,549,382 (in 1908, 1,476,444 marks). The dividend remains at 12½%, but the carry over is increased from 39,513 to 72,206 marks.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Some important papers on turbine management and on some of the troubles incidental to their management, were read at the recent convention at Cedar Point of the Ohio Electric Light Association. Mr. W. C. Anderson, dealing with low pressure turbines, pointed out that in steamship practice a coal consumption of one and one-half pounds of coal per indicated horse-power hour, including all auxiliaries, was not unusual. In the small lighting plant with high-speed engines the coal consumption is nearly four times as great to develop the same energy. In order to improve the economy of such small stations requires the discarding of the old generating equipment, which is justifiable chiefly when considerable new off-peak load can be secured. By the use of the low-pressure turbine, where condensing water is available, the economy can be greatly improved without discarding the investment in engines, etc., already made. The small, non-condensing plant can be improved only by selling its exhaust steam for heating or changing to a condensing system. In the latter case arrangements must be made for carrying the highest possible vacuum. By improvements in condensing equipment it is now possible to maintain a vacuum of 28 in. or over easier than it was to maintain a 26 in. vacuum formerly. Mr. Anderson spoke of the great flexibility attainable by the use of a turbine, as shown by a 580 kw. unit installed in his plant. This is operated floating on the line and using such exhaust steam from the non-condensing engines that is not needed in the exhaust-steam heating system.

Troubles and their Remedy.

A paper by Mr. Frank Brosius dealt with the difficulties encountered by the writer while operating two 500 kw. and one 1,500 kw. vertical Curtis turbines. The first trouble touched on is the loss of pressure on the oil or water used in the step bearing. If the step bearing is dropped there is imminent danger that the buckets will rub, so the turbine must be stopped immediately. In one instance the stop on the large unit was lost and soon every intermediate bucket was stripped. Although the loss of the step bearing in the early days of the Curtis turbine was more frequent, it did not give as much trouble as hot cranks on the old high-speed engine. To ensure keeping the pressure on the step bearing the step pumps must be frequently packed. For the smaller units motor-driven triplex step pumps were installed for regular service and an automatic steam pump for emergencies; the latter starts up as soon as the pressure drops 5 lbs. The steam end of this pump must be kept drained and the pump must be tried occasionally by dropping the pressure on the electric pumps. The top, middle and bottom bearings must be kept in perfect condition and alignment or trouble results from vibration. Proper lubrication must be provided without flooding the bearings with oil. To prevent the throwing of oil into the generator tight-fitting felt collars were placed around the shaft above the middle bearing and below the top bearing. Sticking of the controlling valves gave trouble till they were fitted with two cast-iron snap rings each. To prevent leaking the needle valves must be watched constantly and kept tight. The coils on the solenoid-controlled valves were burned out so that the needle valve could not be controlled. The mechanically-operated valves gave practically no trouble. Carbon packing rings on the shaft to seal the turbine for vacuum must be very carefully fitted and occasionally re-fitted to prevent any leaks. Mr. Brosius commends the water step bearing to the oil step because it eliminates one set of carbon packings. The generator must be kept thoroughly clean and free from oil or condensed steam. There has been considerable controversy on the effects of superheated steam on cast-iron pipe fittings. It seems to be conceded that sudden and high temperature changes are injurious to cast-iron fittings, unless they are of the finest quality close grained metal. Foundries do not take the trouble to turn out such castings; therefore it is practically imperative to use steel fittings for superheated steam, to be on the safe side. Mr. Brosius concluded his paper by giving the results of wear on two almost identical high-pressure cylinders of adjoining compound engines. One served excellently, showing but slight wear after six years of continuous service; the other wore rapidly, shoulders had to be cut out on both ends several times and the cylinder twice rebored, finally being provided with a cast-iron bushing which has given good results for two years. This difference in service the writer attributed entirely to the difference in quality of castings.

Engineers and the Metric System.

Commenting on the slow progress made by the English-speaking peoples in the adoption and use of the metric system in the regular work of life, the "Electrical World" of this city observes that it has recently been determined and officially announced by the American Electro-Chemical Society that, in future, all papers read before that body and containing expressions in English measure must have the corresponding metric values, to a like degree of numerical precision, inserted immediately thereafter in parenthesis. Credit is due to this society, says the "World," for having led the way in this direction. The same rule, wherever practicable, has likewise been officially announced by the Illuminating Engineering Society as regards its papers and publications. A similar use of metric values has, it is rumoured, been decided upon and officially ordered for adoption in the next six months by the American Institute of Electrical Engineers. "Not even the most rabid anti-metrist can complain against the adoption of the above rule by engineering societies. The advantages of the plan are that it not only furnishes a key to foreign engineers concerning what would otherwise probably remain as pure cyphers in our papers, but it also supplies a numerical check upon the numerical statements appearing in the text. When, for instance, an electric car weighing 50 tons (45 metric tons) of dimensions 50 ft. by 9 ft. by 9 ft. (15·2 m by 2·8 m by 2·8 m) is described in a publication as being accelerated at the rate of 1·5 m.p.h. per second (2·4 km.p.h. per second), the engineer in foreign countries

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ordinarily gives up all attempt at understanding the statement; but when the parenthesis are supplied the statement ceases to be national, and becomes immediately raised to the international plane. We heartily recommend this practice to all engineers and engineering societies."

Electrical Engineering Graduates.

Some extremely interesting and significant statistics relating to the paths along which the graduates of electrical engineering courses in American colleges and technical schools enter into the practice of their profession has been gathered by the Chicago "Electrical Review." The figures relate to the current year and information was received from 38 representative institutions, instructing a total of 565 graduates. In grouping the occupations into which this year's graduates are entering, the apprentice courses of the large manufacturing companies have been separated from other positions in manufacturing establishments, as they are regarded as representing a different and particular class. It is to be noticed that this programme is chosen by 43% of the graduates as the most desirable sequel to their college course in the preparation for more important work as engineers. As 10% of the graduates were not yet placed in any positions this represents nearly one-half of the total number already assigned. The next great demand for graduates comes from the power-plants, central stations, etc. This group has been made to include a few who will be engaged on transmission-line work and other employment connected with power generation and transmission. Twenty-two of the men will take up teaching and ten will pursue further courses of study, making a total of 5·7% who will remain at the colleges. Only 5 men are registered as engaging in work entirely foreign to electrical or other engineering. Eight others enter the commercial offices of electrical concerns. One of the men entering the army will engage in engineering, the other probably not. There is thus a total of 14 men, or 2·5% who will not engage in technical work at the outset. Next after the apprentice courses and central station work the telephone companies make the greatest demand for new men, and this work undoubtedly enlists to-day the services of a greater proportion of college-bred men than ever before. The telegraph companies, on the other hand, call but few to their service, and no doubt recruit their ranks mostly from men who have not been technically educated. Many of their technical positions are filled by men who started in as operators and advanced to more responsible positions after learning the technique of the work by experience. Electric railways also fail to draw men in proportion to their industrial importance. The total number of graduates from the 38 institutions represented is 565. The State Universities turn out over 47% of these men, or nearly half, whereas the State colleges and other technical schools combined furnish 39%. It is to be noticed that most of the men taking graduate studies are from the Universities. Most of the men going into the commercial organizations are also from the Universities.

Chicago Lines and Electrification.

There has been a renewal of the agitation begun a year ago for the electrification of the Chicago railway terminals. The "Railway and Engineering Review" of that city thinks that as a sequel the Illinois Central, which is still the "goat," may be forced to make some move toward electrification, at a time earlier than the strict engineering considerations would warrant. The penalty would be a financial one to the company, but the far-sighted person will realize that anything to the financial detriment of the Illinois Central, or any other railroad, in Chicago or anywhere else, is distinctly to the detriment of its patrons and all those even remotely connected with it. As a second possibility the railroad may be forced to legal means to protect it from gross imposition. This would be a like unpleasant alternative. As a sort of middle ground between the two extremes as expressed above, the problem of electrification in Chicago presents just at this moment, says the "Review," a good opportunity for a course of action that would be a definite step in the direction of ultimate electrification, and yet would protect the railroads from any ill-advised expenditures ahead of the art. Such a move should cover the interests of other roads as well as the Illinois Central, for while the latter is the point of immediate attack, there are several other railroads in the city which are almost equally exposed to a similar demand on the part of the public, and against whom the same agitation might be directed at any time. In fact, the problem of electrification itself is complicated by the relations of each road to the numbers of other roads which touch and intersect it; and any plans relating to the electrification of one railroad would, in a large degree, have to take into consideration other neighbouring tracks. The problem of terminal electrification in Chicago is therefore a city-wide one. To meet it as such, a committee or commission would be necessary, representing practically every mile of trackage within the district. A commission so constituted would be prepared to handle the problem of electrification in the only way it could successfully be handled, and could arrive at results with far more certainty than any investigation of lesser scope.

New Turbine Equipment.

The General Electric Company has received an order from the Edison Electric Illuminating Company, of Boston, for a turbo-alternator of 15,000 kw. regular maximum output rating to be installed in the L Street generating station at South Boston. The turbine, which will be delivered for service in May, 1911, will be the largest prime mover in New England. Moreover, it will be one of the largest turbine sets in the country, with the exception of a similar type to be installed by the Commonwealth Edison Company of Chicago at about the same time; the latter machines will be of 20,000 kw. rating. The new Boston turbine will occupy a floor area 19 ft. long and 17 ft. wide, and its height from the floor will be 35 ft. 9 in. The buckets of the turbine will be carried on a periphery 14 ft. in diameter and the speed of the machine will be 720 r.p.m., which means a circumferential velocity of 6 miles per minute. The new machine is of the vertical Curtis type, with six stages, and its total weight will be 800,000 lbs. The average high-efficiency steam engine if built for this rating would occupy about 10 times the space of the turbo set, the latter requiring only 11,547 cu. ft., or 0·77 cu. ft. per kw.

Electrical Definitions.

To the list of definitions framed by the Standardisation Committee of the A.I.E.E., the following additions have been suggested: [The list referred to by our Correspondent appeared on Page 818, Vol. XLV.—Ed., "E.E."]

6*a*. Two-Phase. A term implying the supply of power through two circuits carrying alternating currents which differ 90° in phase.

9*a*. A Compensated Alternator is an alternator which automatically compensates for the drop in voltage in its armature, or in its armature and the line.

9*b*. A Synchronous Compensator is a synchronous machine running either idle or under load, whose full excitation may be varied so as to modify the power-factor of the circuit, or through such modification, to influence the voltage of the circuit.

11*a*. An Inductor Alternator is an alternating-current generator in whose armature windings the field magnet flux pulsates but never reverses.

11*b*. An Induction Generator is a machine similar to an induction motor, but driven as an alternating-current generator.

21*a*. A Rotor is a rotating member of a machine.

21*b*. A Stator is a stationary member of a machine.

21*c*. Equalising Rings are rings connected to equipotential points of multiple-wound armatures to equalise the voltage between brushes.

23*a*. A Primary Winding is that winding of an induction motor or of a transformer which receives power from an external source.

23*b*. A Secondary Winding is that winding of an induction motor or of a transformer which receives power from the primary by induction. Note: The terms "High-tension winding" and "Low-tension winding" are suitable for distinguishing between the windings of a transformer, where the relations of the apparatus to the source of power are not involved.

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29*b*. *e*. A Transformer-Balancer is an auto-transformer for dividing a voltage in constant proportions, and usually into two equal portions.

29*c*. *f*. An Induction Starter is a device used in starting induction motors, converters, etc., when they are started by voltage control, consisting of an auto-transformer in connection with a suitable switching device.

29*d*. *g*. A Leakage Reactance is that portion of the reactance of any induction apparatus which is due to stray flux.

49*a*. A Synchronoscope is a synchronising device which, in addition to indicating synchronism, shows whether the machine to be synchronised is fast or slow.

49*b*. A Voltmeter Compensator is a device used in connection with a voltmeter to reduce its reading by the amount of the line drop, and thus causing it to indicate the voltage delivered at the distant end, or at any other predetermined point of the line.

49*c*. A Watt-Hour Meter is an instrument for registering total watt-hours. This term is to be preferred to the term "integrating wattmeter."

49*d*. Recording Ammeters, Recording Voltmeters, Recording Wattmeters are instruments which record upon a time-chart the values of the quantities they are designed to measure.

78*a*. *a*. Indicating Meters should be rated according to their full-scale reading of volts, amperes or watts (at unity power-factor in wattmeters).

78*b*. *c*. Watt-Hour Meters should be rated by their power delivery at rated volts and amperes at unity power-factor.

84. The Efficiency of an apparatus is the ratio of its output to its input. The output and input may be in terms of watt-hours, watts, volt-amperes, amperes, or any other quantity of interest, thus respectively defining energy efficiency, power efficiency, apparent-power efficiency, current efficiency, etc. Unless otherwise specified, however, the term efficiency is ordinarily assumed to refer to power efficiency. When the input and output are expressed in terms of the same unit, the efficiency is a numerical ratio, otherwise it is a physical dimensional quantity.

86. Apparent Efficiency. The volt-ampere efficiency, or the ratio of volt-ampere output to volt-ampere input. In apparatus in which a phase displacement is inherent to their operation, apparent efficiency should be understood as the ratio of net power output to volt-ampere input.

Some Suggested Amendments.

As was anticipated, the first list has not met with universal acceptance. Among others the following amended definitions have been put forward:

9. An Alternator or Alternating-Current Generator produces alternating currents, either single-phase or polyphase.

20. *d*. A Frequency Changer converts from an alternating-current system of one frequency to an alternating-current system of another frequency, with or without a change in the number of phases or in voltages.

26. (*a*) Compensator Potential Regulators, also called contact regulators, in which a number of turns of one of the coils are adjustable.

29. *d*. Reactance Coils, sometimes called choke coils, are a form of stationary induction apparatus used to produce reactance or phase displacement.

216. Condition of Apparatus to be Tested. Commercial tests should, in general, be made with the completely assembled apparatus and not with individual parts. The apparatus should be in good condition and high-voltage tests, unless otherwise specified, should be applied before the machine is put into commercial service, and should not be applied when the insulation resistance is low, owing to dirt or moisture. High-voltage tests should, in general, be made at the temperature assumed under normal operation. High-voltage tests considerably in excess of the normal voltages to determine whether specifications are fulfilled are admissible on new machines only. Unless otherwise agreed upon, high-voltage tests of a machine should be understood as being made at the factory.

308. Transmission Circuits. In alternating-current constant-potential transmission circuits, the following average voltages are recommended: 6,600, 11,000, 22,000, 33,000, 44,000, 66,000, 88,000, 110,000.

317. When white lights are used a light turned on should denote danger such as "switch closed" or "circuit alive"; while the light out should denote safety, such as "switch open," or "circuit dead." Low-efficiency lamps should be used on account of their lesser liability to accidental burn-out.

341. Candle-Power. The luminous intensity of sources of light is expressed in candle-power. The unit of candle-power should be derived from the standards maintained by the National Bureau of Standards, at Washington, D. C. The hefner is 0·90 of this unit. In practical measurements seasoned and carefully standardised incandescent lamps are more reliable and accurate than the primary standard.

342. Candle-Lumen. The total flux of light from a source is equal to its mean spherical intensity multiplied by $\frac{4\pi}{1}$. The unit of flux is called the lumen. A lumen is the 4π th part of the total flux of light emitted by a source having a mean spherical intensity of 1 c.p. A hefner-lumen is 0·90 lumen.

346. The Efficiency of Electric Lamps is properly stated in mean spherical candle-power per watt, and preferably in lumens per watt, at lamp terminals.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

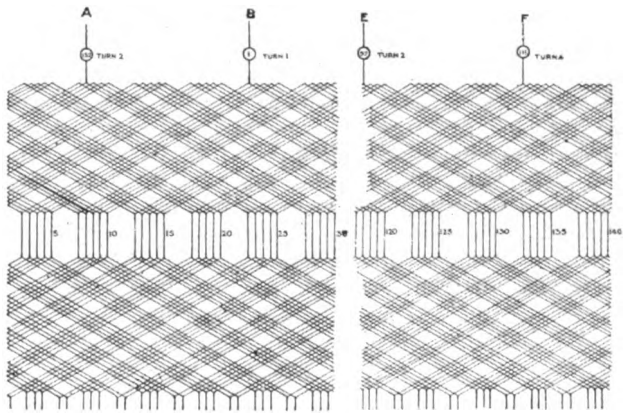
RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

Question No. 1221.—I send print showing windings of a rotary converter; it has four poles and runs on a 420 volts D.C. There are four brushes being connected in pairs and six slip rings marked A, B, C, D, E, F. What are the best connections for one, two and three-phase currents, and what will be the voltages?



Answer to Question No. 1221 (*awarded* 10*s*.)—This rotary is a six-phase machine, and, having two pairs of poles, each slip ring should have two connections to the armature, as shown in diagram. The print of "B.E.W." only appears to show one connection to each ring, which is incorrect.

The proper connections for a six-phase rotary are shown in the upper part of the diagram. The primary of each transformer is wound in two separate equal coils, connected up as shown. The voltage between the terminals of each coil is 257, and between each pair of adjacent slip rings, 148 volts. A three-phase current could be obtained from the slip rings A, C, E, or from B, D, F, volts between phases being 257.

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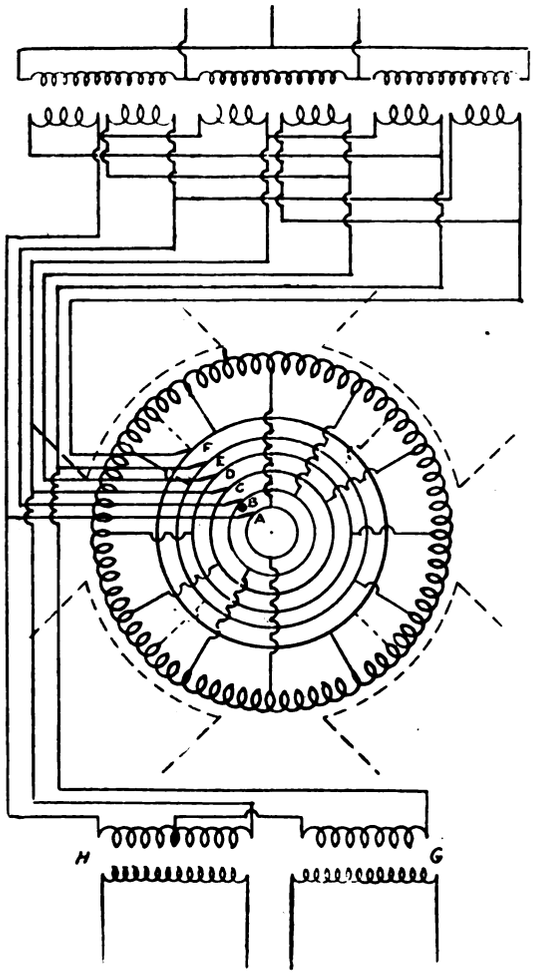
Single-phase could be obtained from A, D; B, E; or C, F; at a voltage of 297; and a two-phase supply from A, D as one phase and E, F as the other, by making the connections to the latter pair of rings as shown by dotted lines, disconnecting those shown by full lines. Voltage per phase, 297.



An alternative method of obtaining two-phase is to use the Scott system of three-phase to two-phase transformation, shown in the lower part of the diagram. The transformer C is an ordinary one, but the primary of H has a tapping brought out from its middle point, the two halves and the primary of G being connected in star. The number of turns in the primary of G must be ·867 of those in the primary of H; the resultant flux due to the two halves of H will then be equal to that due to G, but 90° out of phase with it. The two secondaries being equal, a two-phase current is obtained. The pressure between the primary terminals of G is 147 volts. The pressure across the terminals of H is, of course, 257 volts, but, as explained above, the effect is equal to that of G.—"E. B. P."

REVIEWS.

"The Calculus for Beginners." By J. W. Mercer, M.A. Cambridge University Press. Price 6s.

As Mr. Mercer explains in his preface, this book is written with the intention of teaching the why and the wherefore rather than the actual performance. It, in other words, approaches the subject inductively rather than deductively. While it is mainly intended for students on the science side in schools and in technical colleges, who will have occasion later on to use the Calculus in its applications to physics and engineering, it also forms a sound basis for the mathematician, who will find here a useful introduction to more formal treatises. The book contains a number of exercises with their answers.

"The Depreciation of Factories, Mines and Industrial Undertakings and their Valuation." By Ewing Matheson, M.Inst.C.E. London: Spon, Ltd. Price 10s. 6d. net.

It is at once a proof of the value of this book, and of the growing attention paid to the subject, that a fourth edition should be called for in comparatively so short a time. Mr. Matheson divides his subject into two sections: Depreciation and Valuation, and goes thoroughly into the various phases of the problems as they present themselves in connection with different types of industrial enterprises. In preparing this fourth edition, the author has taken into consideration the application of electricity to many phases of industrial exploitation and municipal undertakings. A special section has been added dealing with official control by Government departments of gas, tramway, electricity and kindred concerns.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "The Editor, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

INDIAN IMPORTERS.

Sir,—We are preparing for publication in India, a Directory of manufacturers of goods and machinery in this country suitable for the Indian markets.

To enable us to make the information as complete as possible, we shall be glad if you would—through the medium of your columns—invite manufacturers in your trade, who are (or likely to be) interested in the Indian markets, to forward us particulars of goods, etc., manufactured by them.

Communications should be addressed to Publicity Manager, The Indo-European Trading Society, Ltd., 4, Maddox Street, Regent Street, W.

Yours truly,
For The Indo-European Trading Society, Ltd.
(Advertising Department),
Lewis Newman,
Manager.

The Indo-European Trading Society, Ltd.,
4, Maddox Street, Regent Street, W.,
London, August 8, 1910.

CAUSES OF LIGHTNING.

Its Origin in Rain.

An important paper by Dr. J. C. Simpson, who lately resigned his post as Imperial Meteorologist at Simla, in order to join Captain Scott's expedition to the South Pole on the "Terra Nova," has been issued by the Indian Meteorological Department. It represents a long course of experiments and observations. While devoted to a theory of the electricity of rain and its origin in thunderstorms, it opens up a most interesting subject for the physicist.

Dr. Simpson's paper is divided into three parts. In the first he describes in detail the method employed to measure and record the electrical state of the rain that fell at Simla during 1907–08, and the results obtained; in the second he gives details of the attempts made experimentally to reproduce what he believed to occur in thunderstorms; in the third he builds up a theory and endeavours to show what actually happens in the case of a thunderstorm. A subsequent short paper slightly extends the observations.

In order to measure the electrical condition of the rain, the drops were received on falling in an insulated metal vessel from which they escaped into a measuring vessel. Every two minutes the electrical charge collected by the insulated vessel was measured by an electrometer and automatically recorded, while at the same time the vessel was automatically discharged by contact being made with the earth. The measuring vessel that held the rain tipped up as soon as 0·014 cm. of rain had fallen, and each tipping was automatically recorded. A device fitted to a coherer registered the stronger lightning discharges and the potential gradient was also recorded at two minute intervals

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by means of an insulated bamboo rod with an umbrella rib fastened to its ends, connecting to an electrometer. Various precautions were also taken to ensure that the results should not be vitiated by external causes. The following were the more important conclusions reached :—

(1) During 71% of the time that charged rain fell the charge was positive.

(2) 75% of the electricity brought down by the rain was positive.

(3) Light rain was more highly charged than heavy rain.

(4) All rainfall which occurred at a greater rate than a millimetre in two minutes was positively charged.

(5) The proportion of negative electricity brought down by the rain was slightly greater in the second than in the first half of the storms.

(6) The potential gradient was more often negative than positive during rain.

(7) No relationship between the sign of the potential gradient and the sign of the electricity of the rain could be detected.

Laboratory Experiments.

Experiments were conducted in the laboratory side by side with these observations, the object being to find out the physical process by which electrical separation takes place in thunderstorms. After a number of negative experiments had been conducted to see whether the friction of moving masses of air with different temperatures and humidities caused separation of electricity, to determine if any electrical phenomenon accompanied the freezing or thawing of water, and so forth, Dr. Simpson investigated the effect of the breaking up of drops of water by means of an air blast. The experiments were based on the principle discovered by Lenard, that if air ascends with a greater velocity than eight metres per second no water can fall through the current, for, if the drops are below a certain size they are carried upwards with the air, while if they are above a certain size they are unstable and break up into smaller drops. This phenomenon Dr. Simpson thought might be the underlying cause of the electricity of the thunderstorm.

Before long it was determined with certainty that the breaking up of large drops on an air jet gave to the water a considerable positive charge. The method of experiment was to allow water to drop from a funnel on to an air jet that came through the middle of an insulated pan placed to collect the drops that fell, after they had been broken up. An electrometer measured the charge on the pan after each hundred drops had fallen. It was found that the charge per drop was $4{\cdot}2 \times 10^{-3}$ els. units of positive electricity.

Various experiments were undertaken to prove that the electrification was not due to such other causes as the Lenard effect, the air blast itself, or the electrification of the drops before they were broken up, and to make the test more general a large blast of air was substituted for the concentrated air jet previously used. The following conclusion was finally reached :—

When waterdrops are broken up in the atmosphere a separation of electricity takes place, the water becomes positively charged and the air negatively charged, and further, the amount of separation is independent of any charge previously on the drop.

Theoretcal Conclusions.

In order, says the author, that the breaking up of the rain drops may be regarded as a satisfactory explanation of the phenomena of a thunderstorm, it is necessary to show :—

(1) that there is a considerable breaking up of raindrops in a thunderstorm ;
(2) that the quantity of electricity which could be developed in this way is sufficient to account for the electrical effects observed ;
(3) that the general meteorological conditions which usually accompany thunderstorms agree with the explanation.

As regards the first point, it is generally admitted by meteorologists that upward currents are observed in thunderstorms, while in the tornado and the hailstorm, where these upward currents are matters of common observation, the electrical phenomena exhibited are conspicuously violent. Dr. Simpson shows that if only an upward current of eight metres per second existed, enough water would be deposited (owing to lowering of temperature) to cause a considerable separation of drops.

From this point he proceeds to determine the amount of electricity that would be formed. He shows that it is reasonable to assume that 36 drops of water, each large enough to be broken up, will have accumulated in the course of 10 minutes over each square centimetre of the ascending surface, and from this he calculates that it does not seem at all improbable that with even moderate values of the ascending current sufficient breaking of drops should take place to give the frequent electrical discharges observed in thunderstorms. Suppose, he continues, that the ascending current is four kilometres in diameter, and that each discharge neutralises the charge over one square kilometre of area, then it would take 12 discharges to neutralise the electricity over the whole surface. Under these conditions, if the potential gradient were being created at the rate of 30,000 volts per centimetre every minute, the lightning discharges would occur on the average every five seconds. These considerations would explain both the positive electricity observed on rain in the initial stages of a thunderstorm and the negative charges subsequently found, the latter charges being given up to the rain by the clouds negatively electrified.

Description of a Thunderstorm.

In the concluding pages of the paper the course of a thunderstorm explained on this basis is given.

Extensive currents of not exceedingly dry air start rising, producing cumulus clouds. As the rate of ascension increases, attaining over eight metres a second velocity, all water will be retained, and owing to the breaking up of drops electricity will be separated, the water becoming positively charged and the air negatively. The splashing caused by the collision of the drops will increase the electrical separation. As the current spreads horizontally its velocity is reduced, and water will accumulate to fall as positively charged rain. Gusts and lulls will all help by further breaking up the rain and by causing splashing to produce discharges.

Meanwhile the negative electricity in the air, probably in the form of free negative ions, will be carried away from the vortex more swiftly than the water, and will be absorbed by the cloud particles with which the air is filled. This condition will favour rapid combination of water drops and considerable rain, negatively charged, will fall.

In this way it is seen that the theory fits in with the observed facts, positively charged rain falling in the initial stages of a thunderstorm and negatively charged rain later. The cause of the formation of lightning is also explained.

In a short appended paper, Dr. Simpson concludes that :—

(1) More positive than negative electricity is brought down by snow in the proportion of about 3–6 to 1.

(2) Positively charged snow falls more often than negatively charged.

(3) The vertical electrical currents during snowstorms are on the average larger than during rainfall.

(4) The charge for unit mass of precipitation is larger during snowfall than during rainfall.

Colloid-Tungsten Lamps.

The Imperial Lamp Works (Brimsdown), Ltd., have issued a four-paged illustrated circular of their lamps, in various shapes and powers. These lamps are of the best British manufacture, and the colloid-tungsten metal filament has been proved to be reliable, of remarkable strength and high efficiency. A smaller, neatly printed leaflet for general distribution is supplied by the firm, with dealer's name and address placed on the cover. These can be obtained on application to the Imperial Lamp Works, and ought to be useful in attracting customers.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

AMBLE.—The Central Hall Wallaw Picture Company, having removed their engine to the Station Hotel Yard, have received permission to run electric wires (low tension) between the Station Hotel Yard and the Central Hall. The distance is about 180 feet, and the wires will be carried upon poles, the Board of Trade requirements being complied with.

BOVEY TRACEY.—The Newton Rural District Council have approved the erection of overhead cables by the company who propose lighting the parish by electricity.

DUNDEE.—The revenue for the electricity department for the past year was £7,935. After paying interest, etc., paying £1,037 into sinking fund, placing £475 to reserve, there was a balance of £67. The reserve and depreciation accounts now total £3,203, which is considered satisfactory. It has been decided to grant a discount of 2½% for payment of accounts within a fortnight, and to reduce the charge for current to the tramways from 1½d. to 1 1-12d. per unit. The cost of production at present stands at 1·29d. per unit.

ECCLES.—The borough may be congratulated on the work of the electricity department during the past year. The revenue amounted to £9,682, and the expenditure to £5,285. After paying interest, sinking fund charges, etc., there was a net balance of £1,217, which was transferred to capital account for expenditure in excess of Local Government Board sanctions; 309,575 units were sold to private consumers, 764,778 for tramway traction and 88,754 for public lighting.

HORNSEY.—A nice little problem is likely to come before the Law Courts. In March the Borough Council wrote to the North Metropolitan Electric Power Supply Company, complaining that by supplying the local cinematograph theatre in Frobisher-road, they had acted *ultra vires*, but suggesting a conference to arrange a *modus vivendi* as regards supply of premises on the borderland. It was suggested that as a matter of general principle as regards border cases the profit made as agreed between the borough electrical engineer and the engineer-in-chief of the company should be apportioned between the Hornsey and Tottenham areas according to the rateable values in the respective districts of each of the premises which are supplied, the non-supplying authority receiving a moiety of the profit earned within its own area. The company, however, declined to agree. The Parliamentary and General Purposes Committee have therefore given instructions for a case to be submitted to counsel for his opinion, and for the company to be informed in the meantime that, having regard to the terms of their letter, the council are taking steps to protect their rights.

KING'S LYNN.—A number of private consumers have applied to the council's electricity works for supply, the number now being 755. The storage battery is being repaired, and it has been decided to expend an additional £50 in order to renew all the cells.

LOWESTOFT.—The Electric Lighting Committee are in treaty with the Westminster Electric Supply Company, Ltd., for the purchase of a new 45,000 lbs. condenser, at what is considered a bargain.

LYDNEY.—The Chepstow Electric Light & Power Company having applied for permission to supply certain houses at Tutshill, the Gloucestershire Electrical Power Company wrote to say that they were still in existence, but that they would raise no objection if their rights were safeguarded. After much discussion at the Rural District Council, it was decided to raise no objection to the application provided that the rights of the Gloucestershire Company were not interfered with; that if required, the whole should be removed by a six months' notice, and that the maximum charge should be 5d. per unit.

SALISBURY.—The Salisbury Electric Light Company are seeking to obtain a Provisional Order to enable them to extend the area of supply. The matter has been before the Town Council, who see no reason to object, provided the town's right to purchase the undertaking is not jeopardised, and that the company are induced to regulate the water more carefully. The whole question has been remitted to the Finance Committee for consideration.

STALYBRIDGE.—Negotiations are now going forward for the supply of electricity to Ashton by the Stalybridge Joint Electricity Board.

STRETFORD.—The total income of the Urban Council's electricity department for the year ending March 31 was £13,486, of which £3,977 was received from private consumers, £7,006 for traction, and £1,836 for public lighting. The expenditure was £6,371. Of the balance, £2,435 was paid in interest, £2,318 in reduction of loans, and £126 for bank charges. A net balance of £2,229 remained, which has been placed to reserve and renewal funds accounts. There has been an uninterrupted rise in the demand for current by private consumers from the beginning. The last rise was about 5%.

WEDNESBURY.—Certain improvements at the Corporation electricity works have necessitated the addition of a pump room and new chimney. Work on this is to commence very shortly.

WHITEHAVEN.—The contracts for the new work have now been given out. Most of the old plant that is now being replaced has been in use from 1893, and has now become entirely obsolete and inefficient. The works first commenced to supply electricity in September, 1893, only one month later than the commencement of the electricity supply in Manchester. With the new plant now being installed, and the extensions of mains, it is confidently anticipated that by reduction in working costs and a vigorous pushing of the sale of electricity, the undertaking will soon be put on a sound and profit-making basis. The ratepayers will then reap direct, as well as the indirect benefit which they have been enjoying for so long.

OVERSEAS.

BUENOS AIRES.—A concession has been granted to Messrs. Paquet & Company for an electric conveyor across the Riachuelo near Colle Garilbaldi.

LAUNCESTON, TASMANIA.—The question of water power *v.* steam power for the city electricity station is still being discussed. A steam stand-by plant is likely to be adopted. Meanwhile representatives of electrical engineering firms have been here, the Germans and Americans being specially energetic.

ROME.—The "Gazzetta Ufficiale" of August 2 publishes a decree containing particulars of the 21 sections of telephone lines provided for by the new law relating to telephone lines in Italy, and the cost of each. The four longest sections are Genoa to Milan, 108 miles; Venice to Udine, 79 miles; Rome to Naples, 161 miles; Catania to Messina, 63 miles.

ULVERSTON, TASMANIA.—An endeavour is being made by certain councillors to have the municipal electricity generating station removed to a new site, and to have water power replaced by steam power.

TRACTION.

HOME.

BACUP.—The Board of Trade have confirmed the order of the Light Railway Commissioners sanctioning an electric tramway to Shawforth, which will link up Bacup with the Rochdale systems.

BIRKENHEAD.—The Corporation tramways are in a fair way to become a very profitable concern. Mr. W. Wyld, the general manager and engineer, shows that the income for the past year was £55,754, an increase of £602. Meanwhile the expenses were reduced by £1,675, and this in spite of there being an increase in rates of £126, upkeep of permanent way £360, passenger shelter £57, all paid out of revenue. The gross profit was £22,956, and the net profit £1,832, as against a loss of £407 in the previous year. The balance has been placed to the credit of renewals account. The very sound policy has been decided upon of forming a depreciation fund; this will be opened next year with a sum of £1,000. Mr. Wyld succeeded in reducing 1,000 yards of corrugations on the rails by means of "Carborundum" blocks fitted as slipper blocks on the snow plough.

LONDON, BERMONDSEY.—The work of electrifying the London County Council tramways from Dickhead, Bermondsey, through Deptford to Greenwich, is well in hand.

RAWTENSTALL.—Sanction has been obtained for an extension of the Corporation tramways from Waterfoot to Water.

WIGAN.—Mr. Mallins, general manager of the Liverpool Tramways, has handed in his report on the Wigan system to the Town Council.

OVERSEAS.

BADEN.—The Government are commencing the work of electrifying the State Railways by making a trail on the Wiesenthal Bahn, which runs from Baden-Baden to Busel in Switzerland, a distance of about 95 miles.

MILAN.—With a view to cope with the great increase of traffic on the Milan-Varese electric railway, and in order that some of the heavy trains now worked by steam may be run by electric traction, the Minister of Public Works has decided that arrangements shall be made for the purchase of an adequate number of new electric locomotives.

VALPARAISO.—A decree of the Chilian Government has been published authorising Mr. Owen Leonard McDermott to construct an electric railway between Antofagasta and Mejillones. Work must be commenced within 12 months and the line completed in two years from May 28 last.

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COMPANIES' MEETINGS AND REPORTS.

UNDERGROUND ELECTRIC RAILWAYS.

Report for half-year shows surplus of £26,392 after providing for fixed charges. Interest at the rate of 1% per annum is announced on the Income bonds. Income from investments shows an increase of £12,906, or about 17%. Since closing of the accounts £54,652 has been received from the estate of the late C. T. Yerkes on account of unpaid calls on shares and interest. On account of interest accrued to June 30 £6,500 has been credited to revenue account in the last half-year, making, with the amount credited in the previous half-year, a total of £13,000 credited to date on account of accrued interest.

TURNER, ATHERTON & COMPANY.

The annual meeting of Turner, Atherton and Company, Ltd., of Denton, Stockport, and America, hatters' machinists and electrical engineers, was held in Manchester, when Mr. Giles Atherton (chairman) moved the adoption of the annual report, which recommended a dividend of 12½% for the half-year, making 10% for the year, free of income tax, on the Ordinary shares, at which rate dividends have been paid on the Ordinary shares since the incorporation of the company ten years ago. The reserve funds now stand at £12,000, and the amount carried forward after payment of dividends is £4,853. Mr. Albert Turner seconded the motion and it was carried.

BARBADOS ELECTRIC SUPPLY.

The statutory meeting of members of the Barbados Electric Supply Corporation, Ltd., was held at Basildon House, Moorgate-street, E.C., Mr. Leslie Whittem Hawkin presiding. He stated that the meeting was called in compliance with the Companies Consolidation Act. The electrical line Order was sanctioned by both branches of the Barbados Legislature in May last. Since the issue of the prospectus Mr. W. C. Kenny had joined the board and Mr. W. C. Shettle had been appointed general manager and resident engineer in Barbados. With regard to the demand for electrical energy the reports received were of an encouraging character. The greater part of the plant and materials required for the equipment of the undertaking had been ordered, and a portion of this had already been shipped. A site had been secured, and it was anticipated that construction work would shortly commence.

LIVERPOOL OVERHEAD RAILWAY: SLIGHTLY IMPROVED RESULTS.

Sir William Forwood, presiding at the half-yearly meeting of the Liverpool Overhead Railway Company, said that passengers had increased from 4,900,216 to 5,090,080, the increase being mainly in workmen's special return tickets, due to a slight improvement in the volume of trade passing through the port, and the reduction in sectional workmen's fares. The increase in the revenue was £824, while the expenditure had been reduced by £524. The traffic arising from the connection with the Lancashire and Yorkshire Railway continued disappointing. The future of the railway depended largely upon an improvement in the trade of the port. The vessels entering the port and their tonnage showed a decrease of 60 vessels and 140,491 tons, but the outward clearances, both in ships and tonnage, showed a small increase. The Overhead Railway was more dependent on imports than on exports, as it was the imports of raw produce which gave the greater amount of employment. The railway should benefit by the construction of the new Atlantic dock at the north end, which was to be proceeded with at once. The report was adopted.

LONDON STREET TRAMWAYS.

An extraordinary general meeting of the London Street Tramways Company was held at Winchester House, E.C., to consider a resolution authorising the directors to distribute amongst the shareholders the balance of the available funds of the company. Mr. George Ennis presided, and remarked that up to the present the shareholders had received a return of capital equal to £6 per share, and they had also been receiving their regular dividend. It was proposed to pay them at once a final dividend of 2s. per share, and about the middle of September they would receive their final payment upon capital account, which was equal to 8s. per share, so that the return of capital would be about £6 8s. per share.

Mr. J. Barber Glenn, a director, in seconding the resolution for the distribution of the balance available, pointed out that during the dividend period, prior to the lease which was taken over by the North Metropolitan Tramways Company, their company had returned in dividends £337,548. The dividends had never been lower than 4%, and had been as high as 9¼%, while for a great number of years they had ranged from 6½% to 7½% per annum. Reviewing the annuity period, he said that during the twelve and a half years that it had been in force a total sum had been paid over to them of £93,000, of which there had been distributed in the shape of dividends £89,000 odd. The resolution was unanimously agreed to.

METROPOLITAN DISTRICT.

Sir George Gibb, presiding at the meeting of the Metropolitan District Railway Company, expressed his pleasure that on that occasion, the last on which he would be able to address them from the chair, he should have to submit a report and accounts of so satisfactory a nature. They had, he said, enjoyed a record half-year, having carried 36,000,000 passengers, or an increase of 3¼ millions, and having taken £26,000 more. Their season-tickets were up 29½%, or £8,389, and, generally, it was to be noted that the improvement had come from all over the system. There had been a saving also of 3¼% in the working expenses, part of which came under the heading car repairs—in the corresponding half-year there had been a charge for the conversion of the side-doors from pneumatic to hand-working—and also under the heading train working. Their electric current had cost them 23% less, largely the result of the substitution of one type of steam turbine for another in the power-house. Speaking generally of the results of the half-year, which, he said, were rather better than he had anticipated, Sir George urged that they might regard the guaranteed interest as practically assured thenceforth, while the First Preference stock, which should not have to wait very long before receiving its full interest, was to receive 3%, with £8,527 forward. Sir George concluded with a brief retrospect of the four and a half years that had elapsed since he accepted the chairmanship, at a time when "your darkest days were just beginning." He showed how the receipts had risen from £204,000 to £280,000, an increase of 37½%; how the train mileage had grown 38½%, and how the number of trains per hour had reached 36 and might soon touch 40. A shortage of £40,000 in the amount needed to meet the Debenture interest had been converted to a surplus of £62,000, and it might truly be said that since 1901, when, with the opening of the Central London, the District began to head towards physical ruin and financial bankruptcy, the line had been saved for the benefit of the public and the advantage of the stockholders. The motion for the adoption of the report was seconded by Lord George Hamilton, who is to succeed Sir George Gibb in the chair.

COMPANIES REGISTERED.

LOCH LEVEN PIER COMPANY.—£50,000 (£10). To take over that part of the undertaking lately carried on by the Loch Leven Water and Electric Power Company, Ltd., which consists of a pier at Kinlochleven, in the parish of Lismore, and Appin, in the county of Argyll, and the rights in relation thereto conferred on the said company by the Loch Leven Water Power Order, 1908. Private. Table A mainly applies.

TITAN ELECTRIC COMPANY.—£80,000 (7,998 £10 and 20 £1). To adopt an agreement with S. de Szepczynski for the acquisition of a business of manufacturers of electric batteries and accessories. Minimum cash subscription, £2,000. First directors (not less than three nor more than seven) to be appointed by signatories. £50. £100 each per annum and a percentage of the profits. Salisbury House, London-wall, E.C.

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PATENTS.

Block Signal Systems.

24017.—1909. British Thomson-Houston Company, Ltd., London, E.C. Sources of alternating current connected across the rails at intervals supply power to a number of track relays which are de-energised by a car at different points in its movement along the track. A home signal is placed at the shunting point of one relay by which it is controlled. A distant signal is placed at the shunting point of a second relay and is controlled by the second relay and by the home signal in advance.

Electric Switches.

24109.—1909. H. J. Carrigan, Buffalo. This combination electric switch has a movable contact which engages with any of the fixed contacts concealed within a casing. A baffle disengages the movable contact from a fixed contact when the movable contact and baffle are relatively removed from a predetermined position.

Telephone Exchanges.

26269.—1909. Siemens & Halske, A.G., Berlin. This is an improvement in telephone exchanges of the kind in which a circuit common to a number of other circuits may be closed by a relay comprised in any of those other circuits. The object is to provide for the opening of a common circuit, which has been closed by a relay in one of the several circuits, over a lead associated with the common circuit. The relay of each separate circuit which closes the common circuit has a counterwinding, in addition to the usual winding, which may be connected over an inner contact of the relay with a switch associated with the common circuit and over a back contact with a switch associated with the circuit containing the other winding. If, after the energising winding of this relay, one of the several circuits has received current, the switches belonging to this circuit and to the common circuit are closed in succession, the counterwinding comes into play and causes the release of the armature as long as the energising winding is traversed by current.

Electric Light Bracket.

439.—1910. A. W. and H. V. Down, London, S.E. The bracket comprises a vertical spindle slidably and rotatably mounted at its upper end in a bearing adapted to be applied to a wall. The lower end passes through a gear box fitted to a wall. A tubular arm projects from the spindle and to this a tubular cross-piece carrying two electric bulbs is fixed. The light can be quickly moved sideways by twisting the cross-piece, or raised and lowered by turning a handle. The bracket is claimed to be specially suitable for use in operating theatres or hospitals, etc.

Loud Speaking Telephones.

467.—1910. Siemens & Halske, A.G., Berlin. The transmitter and receiver are both mounted on the inside of the cover of the casing. The receiver has its diaphragm in a horizontal position, below the magnet facing downwards. It is also provided with a trumpet which registers with an opening in the cover and is so fixed to the cover that its walls slope downwards.

Electrically Operated Submarine Mines.

1206.—1910. Elektriska Aktiebolaget, A.E.G., Stockholm. A buoyant mine is electrically connected to the miner operating station by means of a cable. This buoyant mine can be raised and lowered by means controlled from the miner operating station. The operation of the controlling means as well as the raising and lowering are performed by electric impulses transmitted over a common wire in the cable, and a common return.

Electro Deposition of Metals.

2002.—1910. J. A. Covey, Datchet. This apparatus for the economical production of printers' electrotypes, is provided with a ring carrier for the negative electrode. The ring is supported by arms from a vertical spindle mounted to rotate upon ball bearings. The upper surface of the ring has ridges the inclined faces of which form contact surfaces for the mould holders. The positive electrode carrier is provided as a stationary ring carried by arms and has contact surfaces for the reception of the mould holders.

Electrolytic Cells.

2032.—1910. J. R. Crocker, New York. These cells comprise an anode, a co-operating cathode diaphragm and a cathode adjacent. The cathode diaphragm receives the electrolysed material from the cathode chamber. The electrolysed material is concentrated in the cathode chamber. Water vapour is supplied to the cathode diaphragm to eliminate the electrolysed material.

Electrically Controlling Valves.

3697.—1910. F. Lux, Ludwigshafen. Tuned tongues vibrated by a predetermined frequency of alternations are caused to select and close the circuit of an electro-magnetic device which operates valves as required.

Manufacture of Alkaline Accumulator Electrodes.

3733.—1910. L. Marseille & P. Goun, Paris. The electrodes are of tubular form and made from sheets of nickel perforated with large holes, closely bound with wire. The electrode is oxidised so as to form an adherent deposit of nickel sesquioxide.

Electric and Percussion Primer for Cartridges of Ordnance.

4449.—1910. G. Roth, A.G., Vienna. In order to permit the use of large surfaces for the contact pin the primer is adapted to contain the conducting wires for electric ignition.

Controlling Electric Switches.

4697.—1910. H. E. White & F. R. Carichoff, Schenectady. In this system a number of separately actuated switches and a number of magnetically controlled auxiliary switches are interlocked so that when a separately actuated switch is open the auxiliary switch is positively held open, and when closed the auxiliary switch is closed.

Incandescent Filament Support.

6658.—1910. Dr. F. Salzer, Ujpest. The support is formed of any metal but has a galvano-plastic coating of chronium. The coating adheres very closely to the metal body. Such a filament is cheaply produced.

Electric Fire Alarm.

9644.—1910. P. Kukiolka, Friedrichsthal. The alarm comprises two thermometers suspended in different parts of a room. Both thermometers are provided with circuit connections. Directly one thermometer is brought to 5° above the heat of the other the alarm bell is set ringing.

Wireless Signalling.

10817.—1910. R. A. Fessenden, Brant Rock, U.S.A. A conducting screen is interposed between the conductor and the absorbing material so as to prevent the absorption of the energy of the oscillatory currents due to the conductor carrying those currents being in proximity to an oscillating energy absorbing material.

Multiple Fusible Cut-Out.

10961.—1910. A. E. Partington, Sydney, Australia. The cut-out comprises a barrel of non-conducting material provided with a number of fuses of the enclosed type, the metallic contacts of which protrude through the discs forming the ends of the barrel and make electrical connection with fixed contacts. The barrel which may be rotated is removable from its bearings for recharging purposes.

Wireless Signalling.

11155.—1910. R. A. Fessenden, Brant Rock. The instrument comprises a conducting surface and a conducting filament adjacent to it, enclosed in an evacuated vessel. The filaments and surfaces are changed heterostatically to produce a varying field of force, and to cause the filaments to move and produce a signal.

Portable Electric Lamps.

13828.—1910. F. R. Lange, Leipzig-Grosszschocher. The lamp comprises a stand on which is fitted a current generator, a lamp, and a switch with connected wires. The stand has a flap which enables it to rest uprightly on a flat surface. A ring at the top of the stand serves as a means of suspension from a wall.

Electric Cut-Outs.

23227.—1909. T. E. Murray, New York. The socket terminals of the holder and the terminals of the fuses of the fuse case are exposed relatively to each other in such a way that in one position in which the fuse case is inserted in the holder the circuit through the fuses is completed, whilst in a reverse position to that just assumed the circuit is broken.

Electric Cut-Outs.

23229.—1909. T. E. Murray, New York. The fuse case holder consists of a block of insulating material provided with a handle. A transverse opening is provided for the reception of a fuse case. Circuit may be broken by withdrawing the fuse case from between terminals in the recess in the base.

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Insulation of Aluminium Electric Conductor Coils.

15896.—1909. Dr. G. W. Kuttner, Berlin. The coils are immersed in a hot aqueous solution of caustic soda and sodium carbonate. The air in the coil is rarefied, so that by pressure subsequently produced the liquid is forced into all the interstices between the individual layers of wire. The coil is heated by means of an electric current within the liquid for the purpose of facilitating the penetration of the liquid.

Automatic Electric Lifts.

16114.—1909. Electromotor Equipment Company, Ltd., & A. J. Barlow, London, E.C. In automatic push-button lifts in which the control parts are contained within a casing fixed in the car and operated by tappets fixed in the lift well, the starting switches are located at a common radius and at equal distance from each other. Each starting switch has a push button. The stopping switch is placed in the centre of the casing.

Automatic Electric Switches.

16273.—1909. T. Ferguson, Altrincham. This automatic switch for switching dynamos into and out of circuit with storage batteries, consists of an arrangement of relay switches comprising a primary electro-magnetic switch actuated by a coil across the dynamo terminals, a secondary electro-magnetic switch with a coil in series between the dynamo and the battery controlled by the primary switch, and controlling the operating coil of a main electro-magnetic switch when the dynamo voltage rises a certain amount above the battery voltage independent of the battery voltage at the time, and which disconnects it again when the voltage of the dynamo falls below that of the battery.

Means for Preventing Overwinding and Underwinding Electrically Driven Cranes, etc.

17516.—1909. H. Wardal & W. R. Story, Gateshead-on-Tyne. A guided striker plate, carried by the travelling nut, has means for causing a lever to act upon a bell-crank lever, one member of which engages with an arm fixed to the arm of the switch to normally maintain the switch, so that when the striker plate arrives at a certain position in either direction it will act on the first lever and bring the bell-crank lever into operation to raise the arm and bring the switch to the off position and stop the motor.

Electric Lamps.

18864.—1909. S. Kraus, Berlin. The lamp has detachable locking means consisting of two pivotally connected arms, one of which contains a magnetic locking device, whilst the other acts in conjunction with catches on the casing so as to form a bayonet closure in such a manner that the protecting glass arranged in front of the lamp can only be removed when the locking device is opened and the arms turned. A reflector is pivoted to the lamp under the ring, which holds the glass in position.

Automatic Battery Over-Charge Preventer.

15888.—1909. H. Leitner, Woking. This device comprises an electro-magnet or solenoid which is rendered operative by a cut-out in circuit between the dynamo and the battery. The magnet or solenoid is provided with a de-magnetising winding and has its armature or coil when open arranged to complete the dynamo field circuit. The armature when attracted breaks or reduces the field and puts the magnet or solenoid in circuit with the dynamo independently of the circuit formed by the cut-out.

Electrolytic Cell.

15960.—1909. J. H. Flood. Stockwell, S.W. This cell is of the kind in which the cathode is of mercury. The mercury is projected continuously upwards from the bottom of the cell in one or more jets. The depth of the cell and the direction and force of the jets are such that the amalgam formed is thrown over the side of the cell into an adjoining vessel. The anode may consist of one or more plates of carbon or other material. The essential feature of the invention is the projection of the cathode and all deposits thereon out of the compartment in which electrolysis takes place.

Electric Heaters.

16547.—1909. F. W. F. Ross, London, W. The heater has an inner threaded core which carries within its grooves the nickel or other metal resistance wires. Between the core and an outer quartz table able to stand high temperatures is a packing material which thoroughly envelopes the core but at the same time allows free expansion and contraction of the resistance wires.

Trolley Heads.

16682.—1909. F. Jackson, Ashton-under-Lyne. The interior of the trolley wheel is bored slightly taper. A bush is fitted within the bore. On each side of the bush is a ball race in which balls are held by means of cones. When the trolley wheel is placed between the forks at the head of the pole, the cones are secured by a bolt passed through the bush and screwed up on the outside of the wheel. The bush is rigidly fixed in the wheel by means of a ring let into one side of the wheel and screwed on to the bush. When the wheel is worn the bush can be removed and fitted into a new wheel.

Electric Arc Lamps.

16924.—1909. F. Proctor, Holloway, N. In order that the lamp will burn in series with others the base plate is provided with two adjustable pins which project towards the rocker. The distance between the pins and rocker is such that when the clutch (which is linked to the rocker for separating the top carbon from the bottom carbon) has descended a certain part of its stroke due to consumption of the carbon, the rocker rests upon the pins and thus relieves the solenoid of part of the weight it has to sustain. This makes the arc unsteady, and finally extinguishes it, after which the arc is immediately restruck and burns normally until the cut off point is again reached.

Electrical Device for Controlling Movements from a Distance.

18624.—1909. P. Viry, Suresines. The device consists of a transmitting station connected with a receiving station by two wires on a single wire in the case of an earth return. The transmitting station comprises vibrating plates equal in number to the movements to be obtained. The vibration periods are maintained by means of electro coils and differ slightly from one another. The receiving station comprises an equal number of vibrating plates arranged in series tuned with the plates of the transmitter. Each of the vibrating plates is provided with a beam returned by a spring and provided with a pawl capable of engaging with the head of an ironclad electro-magnet around which all the plates are arranged. Pressure upon the call button of the transmitter shakes the corresponding vibrating plate which sends a vibrating current of a given period through the circuit which is received by the tuned plate at the receiving station. Cessation of the movement is produced by the emission of a continuous current in the ironclad electro-magnet, the attraction of which depresses the beam and re-engages the pawl.

Systems of Marine Propulsion.

20586.—1909. J. N. Bailey, Stretford. A turbo electro generator set connected to an electric motor for driving the propeller is provided with a controller for regulating the operation of the propelling machinery. A brake is also provided which affects the braking of the rotating element without drawing upon the source of energy from which the prime mover is supplied. The operation of this brake is governed by the controller.

Electric Generating Systems.

20587.—1909. A. G. Livesay, Hale. This system comprises a steam or other heat engine and a second engine operated by the exhaust fluid from the first engine. The engines drive alternating and direct current generators which supply separate alternating and direct current work circuits. These circuits are inter-connected in such a manner that electric energy can be transferred from one to the other according to requirement.

Making and Breaking Electrical Circuits or Contacts.

20786.—1909. C. B. Walker, Solihull. In connection with a worm wheel which directly or indirectly carries a movable contact arm provided with devices for holding the worm wheel from rotation at one time and to release it at another, a rotatable and slidable worm is employed which gears with the worm wheel and slides in either of two directions and effects a quick make and break movement.

Vapour Electric Apparatus.

22827.—1909. E. Podszus, Rixdorf. In this apparatus a column of vapour is produced of continuous formation independent of the shape of the radiation chamber which it traverses. This result is obtained by discharging the vapour through the radiation chamber under an excess of pressure due to effecting vapourisation in a separate chamber.

Insulating Compound.

23225.—1909. British Thomson-Houston Company, Ltd., London, E.C. This new insulating compound is composed of a mixture of kaolin, lime, glass, green silko and red silko reduced to a powder with the addition of asbestos. The mixture is formed into sheets, which are treated with silicate of soda and afterwards compressed and fired at a high temperature.

Electric Cut-Outs.

23228.—1909. T. E. Murray, New York. The upper member of the fuse case holder is arched and has oppositely disposed grooves in the arch wall, the depending member of the fuse case has flanges which fit into the grooves.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Aug. 10	1,688	1,867	— 198	— 274	27¼	27¼	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Aug. 7	1,243	1,213	+ 30	+ 426	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	Aug. 6	7,078	6,611	+ 467	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Aug. 6	5,706	5,603	+ 103	+ 3,145	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Aug. 14	1,373	1,443	— 70	— 123	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Aug. 12	6,116	5,944	+ 172	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Aug. 13	1,339	1,417	— 78	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Aug. 14	283	299	— 11	— 56	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Aug. 13	4,716	4,302	+ 414	+ 1,960	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27*a*
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Aug. 14	2,990	2,986	+ 4	+ 98	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Aug. 11	554	589	— 34	+ 1,614	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	July 29	1,645	1,437	+ 208	+ 3,203	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	249	260	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Aug. 12	185	181	+ 4	+ 28	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Aug. 12	6,081	6,334	— 252	+ 36	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Aug. 13	1,019	1,048	— 29	+ 367	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Aug. 6	17,000	16,648	+ 352	+ 10,286	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Aug. 13	2,671	2,664	+ 6	+ 3,020	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Aug. 10	129	156	— 27	— 141	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Aug. 10	1,377	1,676	— 299	— 510	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,089	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Aug. 7	1,707	1,659	+ 48	+ 37	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Aug. 3	45,956	38,387	+ 7,569	+ 105969	136	119½	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Aug. 13	9,040	8,267	+ 773	+ 4,157	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Aug. 14	15,580	14,757	+ 823	+ 3,459	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Aug. 6	4,558	3,950	+ 608	+ 822	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Aug. 7	6,161	5,886	+ 275	+ 6,547	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Aug. 8	1,463	1,437	+ 26	+ 568	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911*a*	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 3	197	169	+ 28	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Aug. 6	1,337	1,263	+ 73	— 118	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 4	2,977	2,705	+ 272	+ 3,718	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles, *b* Half-years' figures.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Indirect Lighting.

Electricity is being used with rapidly increasing frequency for indirect lighting in America, both for public and private service. In the March issue of the "Transaction of the Illuminating Engineering Society," Easton, Pennsylvania, there is a most interesting report on a discussion of the subject. Mr. Pearson, the engineer of Marshall Field & Company, the huge general stores, laid emphasis on the necessity of frequent cleaning, otherwise there is a loss of efficiency, but the cost of the cleaning must not be overlooked when the expense of direct and indirect lighting are being compared. More than one speaker drew attention to the curious fact that in order to secure comfort much greater indirect light is required during twilight, when both natural and artificial light is being used, then at night time. This extra light should be nearly doubled, and this is best secured by standards and other localised light, to assist a reader or worker. With tungsten lamps, usually one watt per square foot is found excellent for indirect lighting. Friends of uniform lighting are multiplying apace, and this is a point that should be noted by illuminating engineers and contractors over here.

Defective Wiring.

Some of our Tasmanian friends are grumbling very much owing to the competition of incompetent "wiremen," who undertake electric wiring work at cut prices, largely because ignorance permits their scamping work. At Hobart, the capital of the State, there are no municipal regulations as at Launceston, which prescribe the minimum as regards efficiency and safety. But the feeling is growing apace that the whole question of wiring by contractors should be made a matter of State legislation, as it has been in Victoria, for instance, where "wiremen" have to possess a licence, only granted after practical examination. This is found to work well, giving satisfaction both to electrical engineers and to consumers. It is a significant fact that the leading electrical contractors of Hobart have met and expressed their desire for municipal regulations. This is as it should be, for "wiring" is a matter for technical skill. It is easy to go astray without proper knowledge, and then breakdowns, which cause annoyance, if not disaster, may arise, giving a set-back to electrical progress. All should be at one on this point of securing good wiring.

Fire Risks.

Of course, the question touches us here as well. We have model rules as regards wiring, but practically no machinery to see that these are carried out. Fire office rules differ widely, and methods of inspection still more. Our contemporary, "The Drapers' Record," writing of fire risks, sensibly enough dwells on the fact that the very safety of electricity engenders a certain amount of carelessness, both as regards installation and after handling by consumers. It rightly enough points out that a good installation at starting is not sufficient, but that this should be supplemented by periodical inspection. Certainly for drapery establishments and big warehouses this should be an accepted routine, and, as the "Record" suggests, such systematic inspection should be taken into consideration by insurance companies. It would be altogether a fine thing if this were done, for it would then soon be seen that electricity is not to blame for every "mysterious" fire, as some critics would have the public believe.

The British Association.

The British Association meets at Sheffield on Wednesday 31, when Professor T. G. Bonney will deliver the presidential address. There will be a deal to interest electricians. The Committee on Experiments for Improving the Construction of Practical Standards for Electrical Measurements will deliver its report; Professor A. Schwartz will read a paper on "The Mechanical Hysteresis of Rubber"; Professor Ernest Wilson and Mr. W. H. Wilson will bring forward a new method for producing high tension discharges; Dr. H. Stanley Allen will deal with "Photo-electric Fatigue"; and Messrs. W. Makower, S. Ross and E. J. Evans will report on experiments relating to the recoil of radium A from radium B.

Spanish Opportunities.

We have mentioned before that Spain offers a good market for electrical appliances, although, owing to fiscal and other considerations, the best results are obtained when local factories are opened, where heavier parts can be made, and where apparatus may be put together. The Belgians are well aware of the growing demand for things electrical in the Iberian peninsular, and by taking time by the forelock have succeeded in getting a fairly large hold on the market. They have, for instance, a big share in the tramways of the country. Now the Belgian Consul at Granada has reported to his government that, owing to the availability of abundant water power, electrical energy is extensively used in the province of Granada, mainly for lighting purposes. There are three large power stations in the town of Granada, and about a dozen smaller stations in the province. The Consul adds that plans are being drawn up for the utilisation of other large waterfalls in the Sierra Nevada, with the object of supplying electrical energy to the neighbouring provinces. We may add that excellent opportunities present themselves in other provinces, especially as in many quarters hydraulically generated electricity could be used both for lighting and power purposes in the mines and quarries.

Loans Without Public Inquiries.

A rather piquant correspondence has taken place between Mr. P. Percival, secretary of the Manchester Ratepayers' Association, and the Local Government Board. Mr. Percival desired to know whether it was true that the Corporation had been granted leave, without public inquiry, to raise a loan of £40,000 for the electricity undertakings. The Local Government Board replied that the sanction had been given on June 2, no public inquiry being deemed necessary. Thereupon Mr. Percival answers that the Association strongly deprecates such procedure, as it is necessary for ratepayers to keep control over the expenditure of the various Committees. There the matter rests for the present. Sympathy will certainly rest with the Ratepayers' Association. We are not anxious to hamper municipalities, but it is extremely unpleasant to find the Local Government Board lending themselves to such a hole-and-corner arrangement. It was the intention of the legislature that expenditure should be under the supervision of those who had ultimately to bear the burthen, hence the holding of public inquiries, to allow of reasonable objections being put forward. It was never intended that Corporations should be permitted to incur debt simply by securing the goodwill of functionaries at headquarters. It is a spirit of bureaucracy that should not be encouraged. We do not take into consideration the merits of this particular loan. Probably it was needed and will produce a useful effect. But, having democratic rule, such reprehensible proceedings as above are only likely to raise up opposition, and create suspicion that somebody wanted to hide something.

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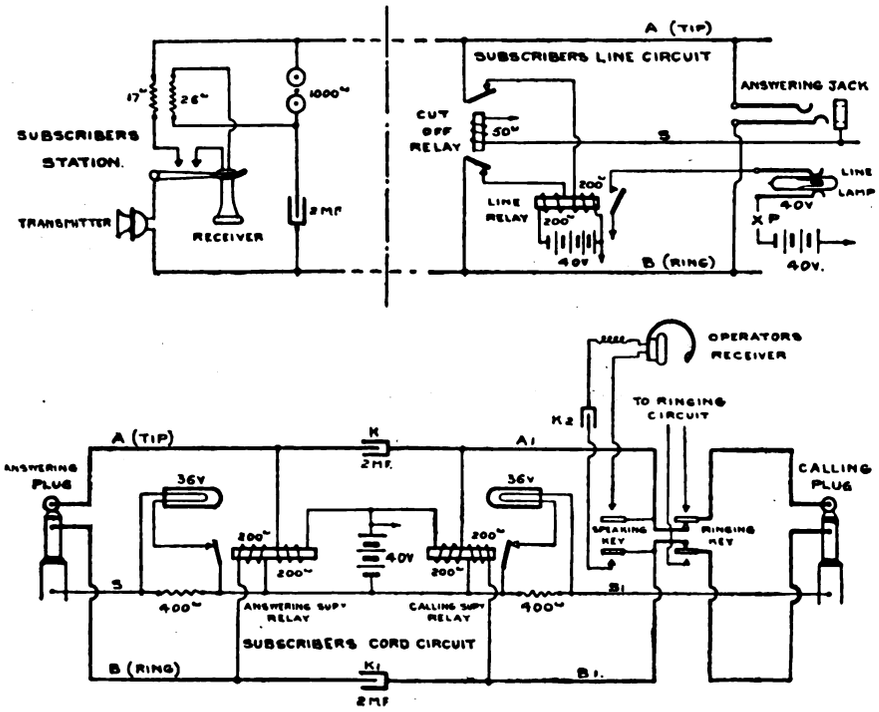
Glasgow Telephone Service.

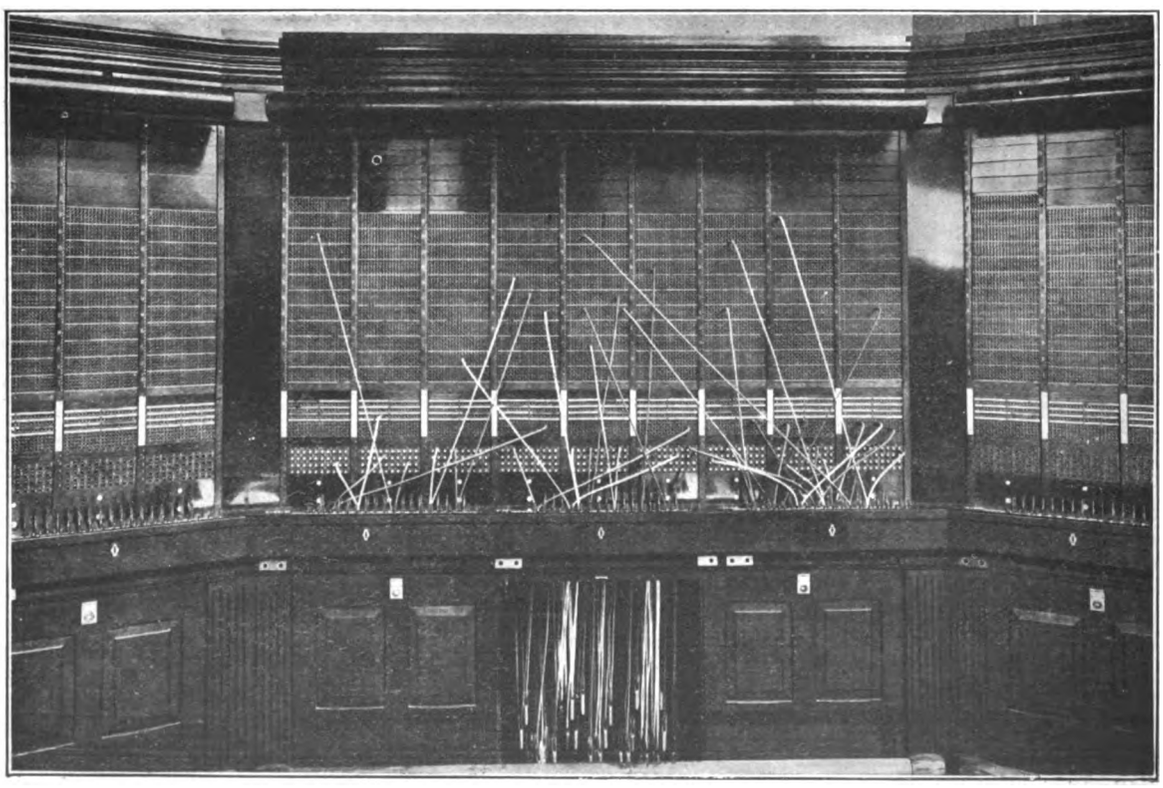
On Wednesday of last week there was an opportunity given to the Press to examine the new Telephone Exchange which has just been erected in Waterloo-street, Glasgow, for the Post Office by the Peel-Conner Company, of Salford. The new exchange, which is situated on the top floors of the new post office buildings in Waterloo-street, is said to be the largest telephone exchange out of London. It has accommodation for 10,000 subscribers' lines, and in every detail is thoroughly in accordance with the most modern practice in telephony.



1.—Subscribers' Line and Cord Circuits.

Equipment.

The "central battery" system of working has been adopted, which reduces to a minimum the trouble to the subscriber in obtaining calls. Lifting the telephone from its rest gets the subscriber into touch with the operator, and putting the telephone back on the rest switches off. It will no doubt take old subscribers some time to accustom themselves to the new system, but when the novel simplicity of the system has been got over, it should enormously add to the efficiency of the telephone service. The cables, 25 in number, with 1,250 wires in each, terminate in a manhole in Wellington-street, whence they are carried in a chute to the fifth floor of the building and there joined to the internal wire system. On the floor of the exchange proper the various cables are led to the main distributing frame on bearers. The circuits are trebly protected against accident from stray currents by lightning arresters, special fuses, and heat coils. The distribution frames, meter and relay racks have been designed so as to permit of easy extension in a lateral direction, the apparatus on both sides of the frame being arranged vertically. Space is saved and compactness attained by the meters and relay covers being square instead of round in shape. The front of the switchboard shows 28 nine-panel sections, one spare nine-panel section, and one three-panel section, or a total of 84 equipped positions. Each section covers 360 subscribers' lines, the ultimate capacity of the board being for 14,400 lines. Each operator deals with 120 lines and has 17 pairs of cords for making connections. The 10,000 circuits are multipled over the nine panels, thus giving each operator access to all the subscribers' lines. Each panel has 160 outgoing junction lines. The details of the arrangements to the rear of the switchboard show many improvements on the older exchanges: the whole of the secondary circuit apparatus is fitted on special racks behind the board, the result being increased efficiency and reduced maintenance



Subscribers' Answering Position, Front View.

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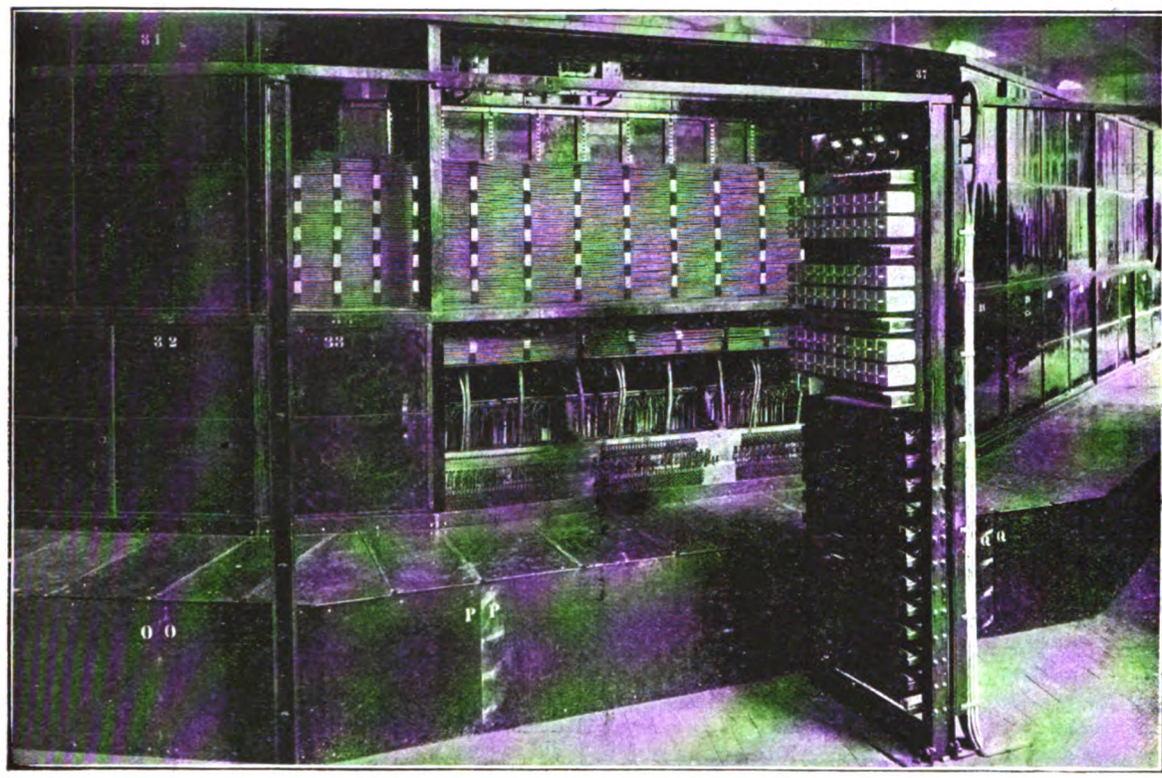
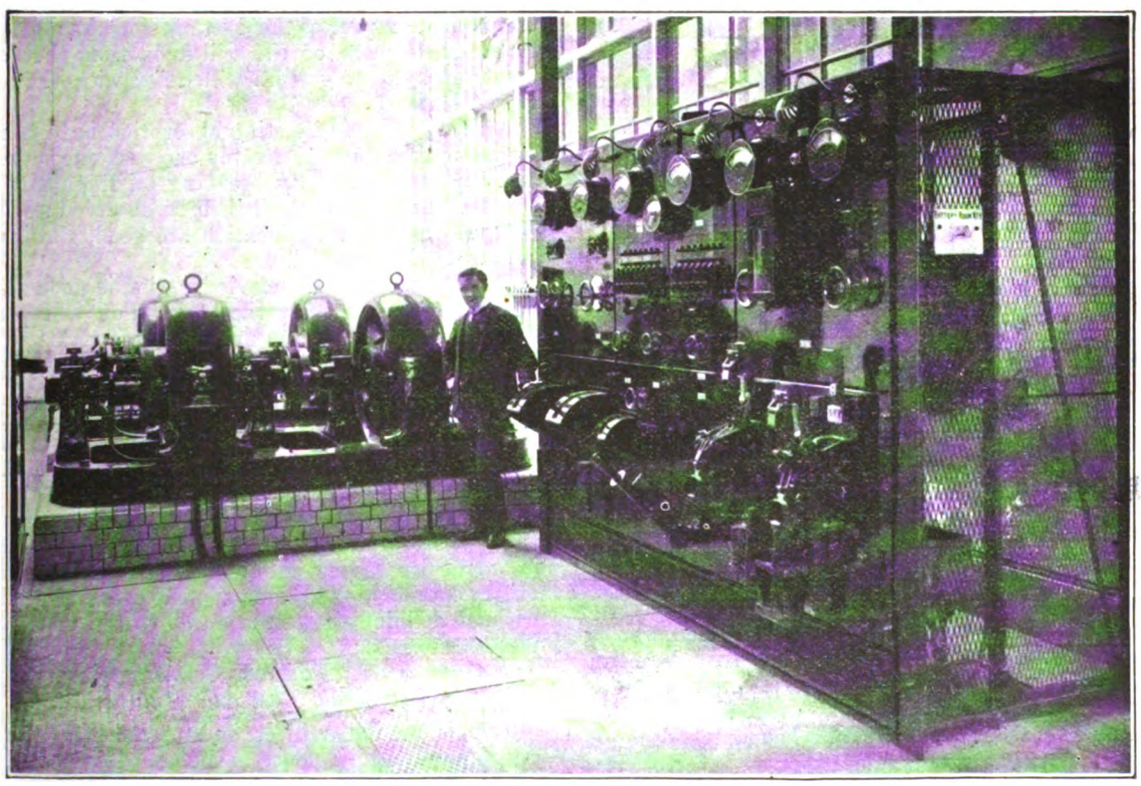


SUBSCRIBERS' ANSWERING POSITION, Back View.

cost. All the boards are fireproof, the use of woodwork having been practically avoided throughout. Every 10 of the 90 operators is supervised by a senior operator. An important feature is the Information Desk, where a number of expert operators deal with complaints, tied up lines, or other difficulties arising between the operators and subscribers at the general switchboard. From this desk also the operators can overhear any communications passing between subscribers and operators at the general board. There is a four-position information desk for general supervision of the work, and there is a lady superintendent for dealing with matters of discipline and general organisation of the service. These are only a few of the general features of this excellent installation, which alike in design and construction reflects the highest credit on the contractors, the Peel-Conner Works, Ltd. It should be mentioned that the motor generators, power switchboard, and the other parts of the electrical equipments were manufactured by the General Electric Company at their Witton Works, from whom, as already announced in these columns, the Peel-Connor Telephone Works, Ltd., took over the telephone branch of manufacturing. The exchange must prove a great accession to the amenities of business life in Scotland's commercial capital.

The Manager of the P.O. Telephones.

Civil servants are said as a rule not to be over civil. The remark has no meaning as regards the staff of the Post Office telephones in Glasgow. Mr. John Macfee, manager of the service in Glasgow, has had some most difficult tasks to perform in connection with the development of telephony in this city, and the fact that he has attained to his present post, after the vicissitudes of the system with which he has been connected, has passed



POWER PLANT.

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through, is a tribute alike to his capacity as an engineer and his character as a man. Mr. Macfee was born in Paisley. He was trained as an electrical engineer, distinguished himself as a student at the technical college, and entered the service of the National Telephone Company. When the Glasgow Corporation entered the telephone business, Mr. Macfee was appointed assistant to Mr. Bennett, the chief engineer and manager; and on Mr. Bennett's leaving, Mr. Macfee was promoted to the managership. The Post Office have wisely retained Mr. Macfee as manager of the system since they took it over from the corporation, and the equipment of the new exchange above referred to has been carried out under Mr. Macfee's immediate direction and superintendence.

UNDERGROUND CONDUIT CONSTRUCTION FOR LARGE TRANSMISSION SYSTEMS.*

Edw. N. Lake.

1. General. 1. *Introduction.*

The use of ducts for installing electric conductors underground is a practice of comparatively recent years. The ducts were primarily a means for placing cables underground and a convenience for repairing and replacing them. In more recent times, however, with the large increase in the amounts of energy transmitted, the additional feature—isolation of the cables—is exceedingly important.

In a very few years' time we have seen the rise and fall, so far as large systems are concerned, of a large number of different forms of ducts. The various forms of wood and the pump log type, the Dorset asphaltic concrete forms, the 10 by 10 in. terra cotta, shown in Fig. 1, are now all practically obsolete and the iron pipe and cement lined pipe are only rarely to be found at this time. The forms at present used are the cement or stone duct, fibre pipe, and the multiple and single form of vitrified clay duct. All of these forms of duct are installed in the same general manner in concrete, and the methods are practically the same as have been used for fifteen or more years.

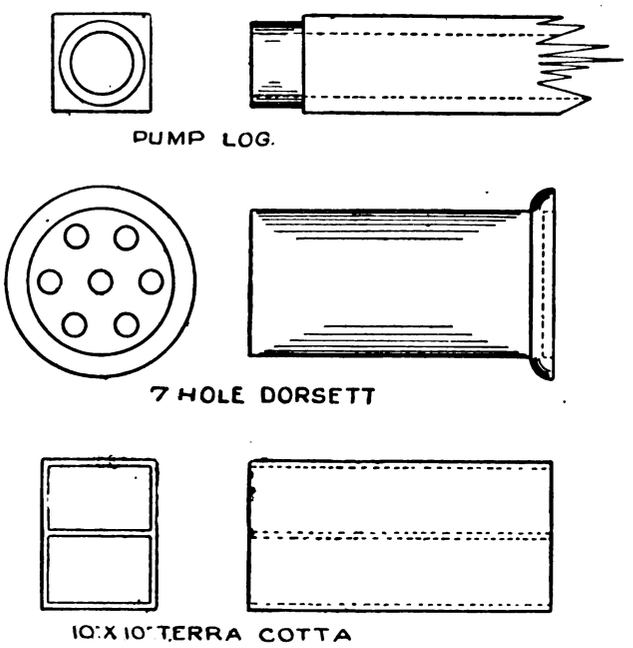

Fig. 1.—Some Obsolete Forms of Duct.

The suggested improvements in this paper are almost all made with reference to the comparatively new ideas of isolation and protection of the cables for which the conduits are built. In this, as in all other matters of engineering design, where prevention and insurance are the basis, the precautions taken and the amounts expended for safeguards will depend entirely upon the importance which is attached to these matters by the men who are responsible for the designs and the expenditures. Numerous cases of burnouts which have seriously affected a larger or smaller number of cables adjacent to the defective one can be cited by almost any engineer who has had to deal with underground conduit installations for the distribution of large amounts of electrical energy. So there is apparently a real need of some improvements which will insure against such spread of *trouble* from one duct to another.

2. *Vitrified Clay.*

The best heat-resisting and arc-resisting material which is available on a commercial basis at this time is undoubtedly vitrified clay.

Where a material is desired for use in contact with flame or intensely heated gases, as in furnace linings, boiler bridge walls, or flue linings; where a receptacle is wanted in which to enclose a high tension insulator when it is placed in the kilns; where a material is to be subjected to the great volume and intensity of heat that emanates from molten metals; everywhere that heat and flame are to be resisted by direct contact, some form of hard-burned clay is used. So when a material is wanted for underground conduit construction that will resist the intensity and volume of the heat of the electric arc, we very naturally turn to vitrified clay in the form of ducts.

3. *Absorption Tests.*

When a small quantity of water is closely confined and exposed to sudden and intense heat, it acts with all the violence of a high power explosive. Tubular steam boilers without water and with the bottom plates overheated have exploded with most terrific force upon turning in only a small quantity of feed water. A drop or two of water in a ladle into which molten metal is poured explodes with disastrous effects. A very small amount of water confined in old scrap castings, such as old pump valves, when not properly broken up and inspected before being thrown into the melting furnace, has been known to explode with force enough to wreck a cupola.

Due to this so-called explosive power of water, it is believed that the walls of a clay duct, which might otherwise withstand the heat of a burnout, if it contains a sufficient amount of moisture, will be rapidly disintegrated in successive layers by the sudden evaporization of the water confined in the interstices, under the action of the intense heat of the arc. Hence, that vitrified clay duct is best for large power distribution systems which will absorb the smallest percentage of moisture.

The following, it is believed, represents in a general way the relation of vitrification and glaze to absorption in this class of duct material:

Vitrification.	Glaze.	Absorption.
Good.	Good.	Minimum.
Good.	Poor.	Slightly larger.
Poor.	Good.	Larger.
Poor.	Poor.	Maximum.

You will see from these relations that if an absorption test is made a part of the duct specifications, the per cent. for a whole piece of tile will differ from that of a fragment, and the fragments will differ with the amount of glazed surface.

A ready means of testing absorption is to take a sliver from a broken duct, preferably one with one surface glazed, and dip it in ink. By breaking off fragments from the tip end, the following will then be observed:—

1. If glaze and vitrification are good, the ink will not penetrate the material.

2. If glaze is good and vitrification is poor, the ink will not penetrate through the glaze, but will penetrate a considerable layer of the unglazed material.

3. If glaze and vitrification are both poor, the penetration will be about the same on all surfaces.

The percentage of absorption permitted will depend upon the importance which the engineer attaches to the matter, and the local conditions as to the kind of duct that can be delivered to the trench at a fair price.

One specification used here in Chicago requires not more than 2% absorption in 24 hours in the whole piece, and 3% in fragments having about 50% of surfaces glazed. Another specification requires not over 5% absorption, without defining the condition as to the whole or broken pieces.

II. Conduit Construction.

4. *Single Duct and Multiple Duct.*

This is an old subject and practices are pretty well crystallized with reference to the use of single and multiple duct; each has its particular field in which it practically

* Paper read before the Western Society of Engineers, Chicago.

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monopolizes the construction, but a word here may not be entirely at variance with the scope of this paper.

For telephone cables, and for all cable systems where the number of heavy cables is not large and where no special consideration of the possible spread of trouble from one cable to its neighbours is thought to be necessary, the multiple duct, Fig. 2, on account of economy of space and convenience in handling, is the logical choice of vitrified clay duct. But for systems which carry large groups of cables where tens of thousands of kilowatts may be concentrated upon a burnout, and where cable separation and isolation must be given its due consideration, the single duct construction, Fig. 3, is believed to be better and is most generally used.

It might be said, in passing, that the single duct is a much more flexible construction for congested city locations where a great deal of manœuvring is necessary to get around or over, or under, or through obstructions. These obstructions, which are the uncharted reefs of the underground territories of any city, are both the joy and the grief of underground conduit work. If it were always a clean ditch, such as Fig. 4, and with no obstructions, underground conduit construction would be monotonous and uninteresting. If it were not for the difficult intersections, of which Fig. 5, reproduced from the "Engineering Record," is a good example, and the satisfaction of getting a good line through them, some of the men who have followed the work for half a lifetime would have dropped out long ago.

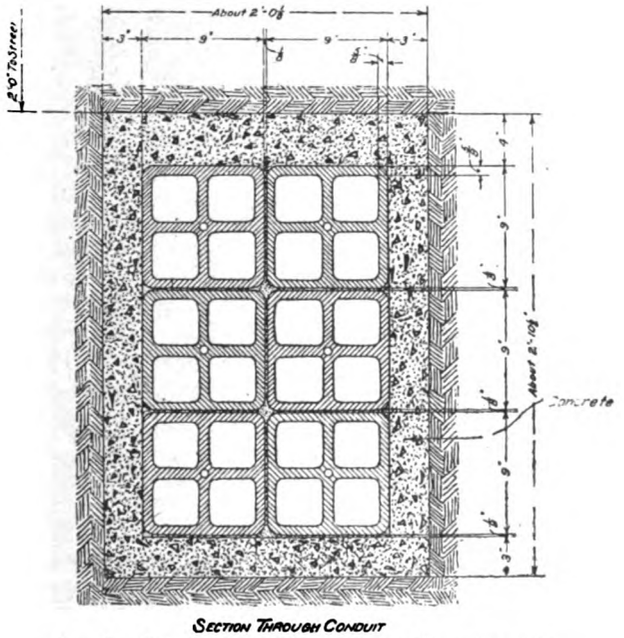

Fig. 2.—Multiple Duct, Standard Construction.

5. *The Corners of the Duct.*

The present standard single duct construction, using $3\frac{1}{4}$ or $3\frac{1}{2}$ in. square bore duct, which is used in most of the larger systems, is shown by Fig. 3, and is believed to represent the best engineering practice for large power systems at the present time. This construction, when properly installed, provides two walls of about $\frac{5}{8}$ in. each of vitrified clay between adjacent ducts, and it has been demonstrated in practice that for ordinary burnouts this is effective in isolating the trouble. In the case of very severe burnouts it has been found, however, that there are certain weaknesses in this form of construction. One of these is due to the present form of corners on the duct, which leaves a void of considerable size. Of the space shown between the corners in Fig. 6, only the lower half is usually filled with concrete, so that a severe burnout will communicate laterally through the joints in the ducts and longitudinally through the voids, and thus injure cables in adjacent ducts.

It is believed that one simple improvement in the duct would consist of slightly modifying its shape so as to reduce the void at the corner to such an extent that it may be completely filled by the mortar in the process of laying. By looking at Fig. 4 it will be seen that by a slight change in the usual outside radius of the corner of the duct, the area of the void at the corner of four ducts is very materially reduced. By going over the drawings with a planimeter it was found that this corner space was in a ratio of six on the present form to one on the proposed form.

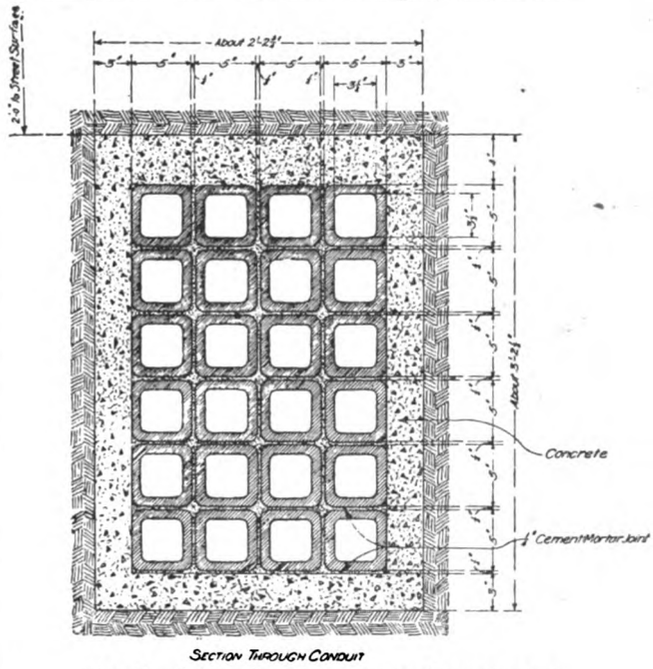

Fig. 3.—Single Duct, Standard Construction.

This change in form was submitted to several of the leading duct manufacturers, and while all agreed that it was not impractical to manufacture the duct in the proposed form, there were the usual objections that are urged to any innovation.

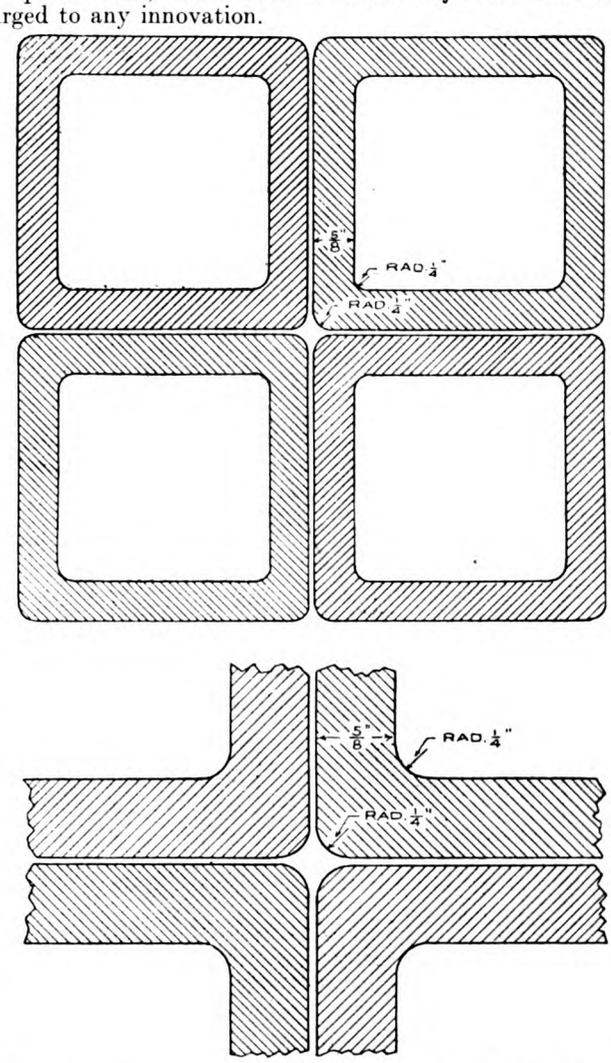

Fig. 4.—Suggested Form of Corners of Ducts With Small Voids.

6. *Definite System of Breaking Joints.*

Another difficulty encountered in the present construction is that, unless very careful supervision is exercised, the joints in the ducts will not be properly staggered as they are laid.

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Take, for example, the middle duct in a nine-duct section, as duct *F* in Fig. 5, which has eight ducts adjacent, whose joints must be staggered with reference to its own joints. This is usually done so far as the four ducts adjacent to the four sides are concerned, as ducts *E*, *J*, *G*, and *B*, but it often occurs that the ducts adjacent to the corners, such as *I*, *K*, *C*, and *A*, have not their joints properly staggered.

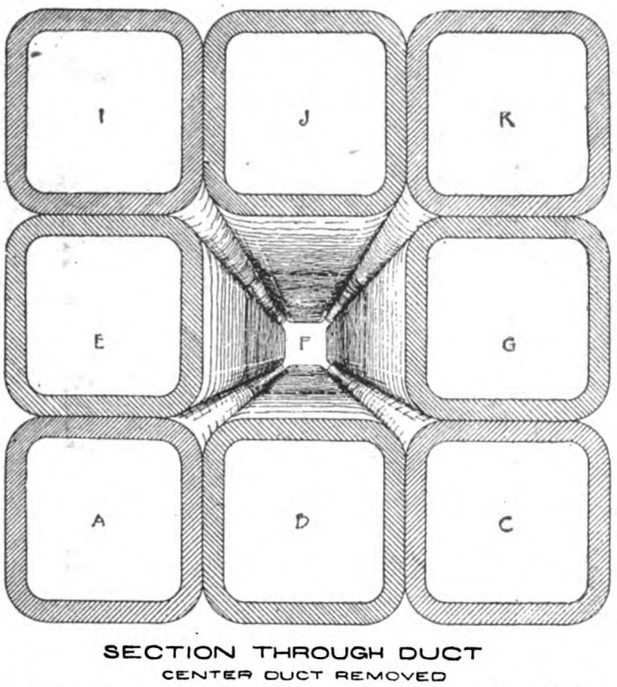

FIG. 5.—A GROUP OF DUCTS, WITH CENTRE ONE REMOVED TO SHOW NECESSITY OF BREAKING JOINTS.

The result of this is that burnouts may occur in a duct, say duct *F*, which would not affect cables in the ducts *E*, *J*, *G*, or *B*, but would melt the lead and destroy the insulation of cables in ducts *I*, *K*, *C*, and *A*.

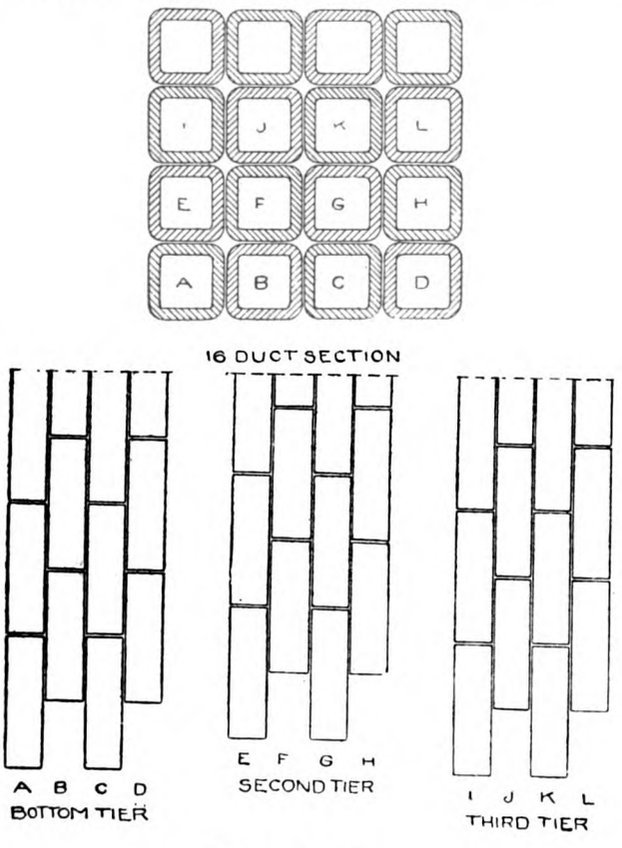

FIG. 6.—PLAN OF BREAKING JOINTS, SINGLE DUCT, STANDARD CONSTRUCTION.

A rigid adherence to a definite plan of breaking joints is not usually followed, but would be of decided advantage in the present construction. For a conduit section of tiers of four ducts in width, the plan shown on Fig. 10 is effective. This is so arranged that joints in adjacent ducts will not be nearer than one-fourth of a standard length, or 4½ in. apart. While this would undoubtedly reduce to some extent the liability of the spread of a burnout, the spacing of 4½ in. minimum between joints in adjacent ducts is manifestly too small, even if it could be rigidly maintained, which is extremely difficult under practical construction conditions.

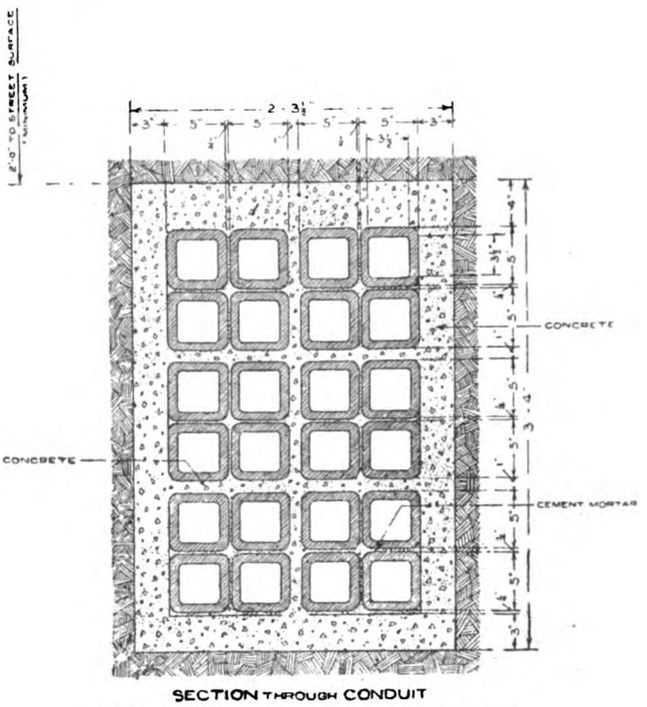

FIG. 7.—SINGLE DUCT LAID IN MULTIPLE.

7. *Single Duct in Multiples.*

One improvement which has been considered consists of installing the present single duct in multiples, with an extra separation by concrete between the multiples. In Fig. 7 is shown a section of this construction, and Fig. 8 shows the corresponding plan of breaking joints. This construction does not overcome entirely the objection due to voids at the corners, and since joints will be as close as 4½ in., a cable failure may involve adjacent ducts in the same group, but it has the advantage of dividing up a conduit line into unit groups which are so thoroughly isolated that the possibility of a cable failure in one group injuring the cables in an adjacent group is very remote.

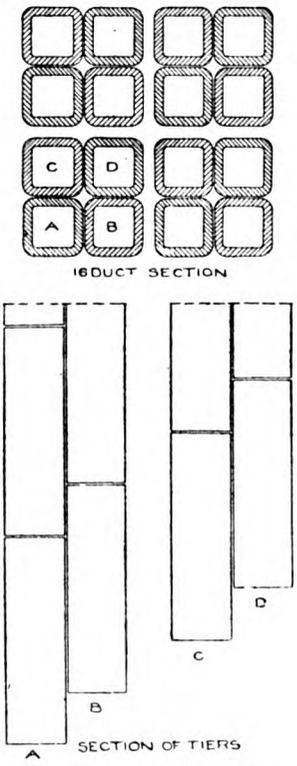

FIG. 8.—PLAN OF BREAKING JOINTS FOR SINGLE DUCTS IN MULTIPLE.

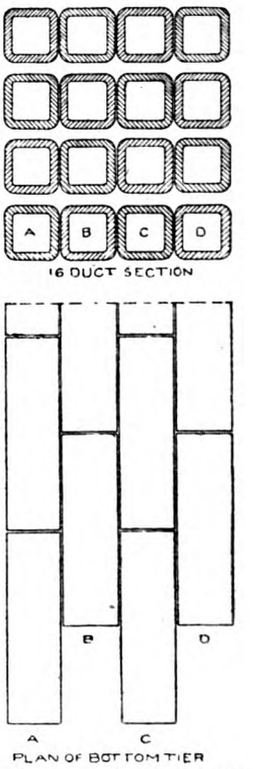

FIG. 10.—PLAN OF BREAKING JOINTS FOR SINGLE DUCTS IN TIERS.

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8. *Single Duct in Tiers.*

Another plan, shown in Fig. 9, is a modification of the above, in which the multiples are in horizontal tiers. Each tier is separated by a substantial layer of concrete. This form is a little more simple in construction, since the layer of concrete between tiers can be spread wet enough to make tampering unnecessary and no spading is required.

This plan possesses the following advantages over either of the other two plans :

1. As shown by Fig. 10, no joints in adjacent ducts are closer than a half length, or 9 in.

2. The voids at the corners will be very largely eliminated with the present form of corners, and entirely done away with if the proposed new form is used.

3. The cables in the unit tiers are very effectively isolated by two $\frac{5}{8}$ in. thicknesses of vitrified clay and 1 in. or more of concrete.

Practical conduit men will look askance at figures upon cost, since there is such an exceedingly wide variation in

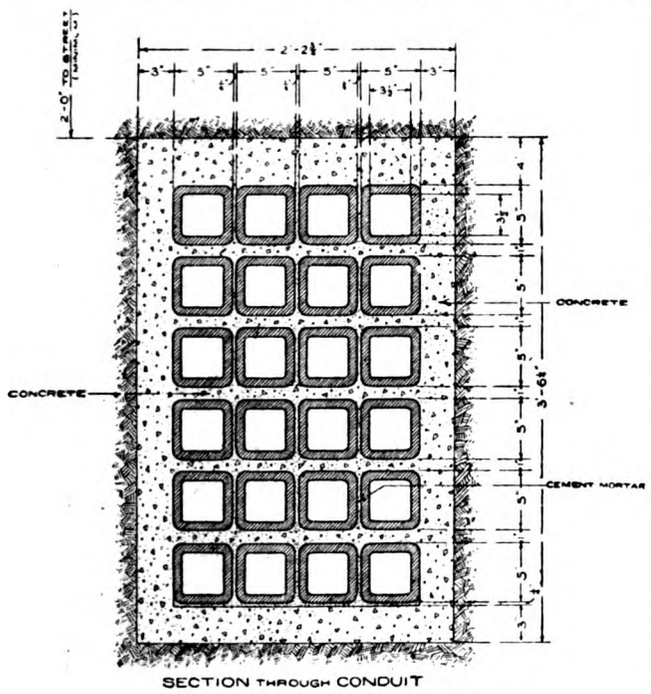

FIG. 9.—SINGLE DUCT LAID IN TIERS.

costs, due to soil, obstructions encountered, weather conditions and the organisation of the conduit gangs. Comparative figures, however, based as nearly as possible upon similar conditions, are here presented to show the relative costs in cents per duct foot of the three different methods of conduit construction :—

Conduit Section.	Standard Single Duct. (Fig. 3)	Single Duct In Multiple. (Fig. 7)	Single Duct In Tiers. (Fig. 9)
4 Duct	27·6	27·6	28·1
6	22·0	22·1	23·0
8	19·3	19·7	20·4
9	18·3	—	19·3
10	18·0	19·6	19·2
12	16·4	17·7	17·5
15	15·0	—	16·3
16	14·9	15·6	16·0
18	14·6	—	15·9
20	14·2	15·1	15·3
24	13·3	14·3	14·5
Average	17·60	18·96	18·68

Taking the standard single duct construction shown in Fig. 3 as the base, a comparison of percentages is given below, and also in the last column is given the cents per duct foot of extra costs which would be involved in using the unit tiers :—

Conduit Section.	Standard (Fig. 2)	Multiple. (Fig. 5)	Tiers. (Fig. 7)	Extra cost of Tiers.
4	100%	100%	101·8%	·5
6	100%	100·4%	104·5%	1.0
8	100%	102·0%	105·7%	1·1
9	100%	—	105·4%	1·0
10	100%	108·8%	106·6%	1·2
12	100%	107·9%	106·7%	1·1
15	100%	—	108·6%	1·3
16	100%	104·7%	107·4%	1·1
18	100%	—	108·9%	1·3
20	100%	106·3	107·7%	1·1
24	100%	107·5%	109·0%	1·2
Average	100%	107·7%	106·1%	1·08c

It will thus be seen that the conduit construction in tiers involves an increase for the average of all of the conduit sections considered of about 6%, or about 1 cent per duct foot. An increase in conduit cost of 6% would seem at first to be more than is justifiable for such improvements. But when considered as additional insurance against cable losses, it is found that the 1 cent per duct foot of increased cost is only a nominal insurance rate. The value of cable per foot of duct may be $1.00 to $1.50, and the connected apparatus which might be endangered by cable burnouts may be of an additional value equal to $1.00 to $1.25 per foot of cable. Taking the minimum of $2.00 per foot for the value of cable and connected apparatus as the basis, the additional cost of 1 cent per duct foot for construction in tiers is equal to an insurance rate of only 50 cents per $100.00 for the first year. The cost for subsequent years will be the interest charge on this additional cost, which at 6% would be 3 cents per $100.00. Upon this basis the additional cost would appear to be not only entirely justifiable but highly to be recommended.

9. *Round Bore Duct for Important Lines.*

Square bore duct has come into general use because two or more cables can be installed with greater ease than in the round bore, and because it is a favourite with the men at the trench on account of greater ease in handling and laying.

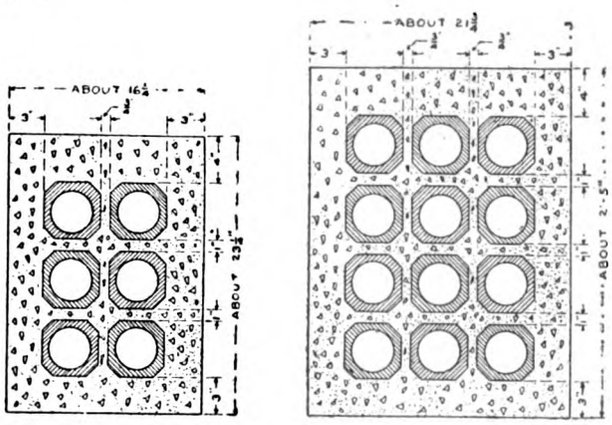

FIG. 11.—ROUND BORE SINGLE DUCTS WITH HORIZONTAL AND VERTICAL SEPARATION.

Round bore duct of the same size takes less clay to make, and is lighter in weight ; there is also less waste due to swelled ends in the drying process, and a smaller number of culls from the kilns, because the shape is such that when piled for burning the heat is distributed more uniformly, and the material is therefore generally better burned and better vitrified.

In ordinary low tension systems the individual cables seldom carry more than 250 to 500 kw. each. In a high tension system, however, 10 to 15 times this capacity may be transmitted in a single cable. In high tension systems the cables are usually of such large outside diameter that only one of them can be installed in a duct. For high tension lines and for important low tension lines involving large amounts of power, where a superior construction is desired, a line consisting of round bore single ducts laid in tiers, with an extra space between horizontal ducts, as shown in Fig. 11, would represent, it is believed, the very highest type of construction possible at this date.

A comparative estimate of the cost of this construction and the present standard square duct conduit, assuming identical conditions and taking only the 6 duct and 12 duct sections, gives the following :—

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	Standard Square. Bore, (Fig. 2)	Round Bore. Special. (Fig. 11)	Extra Cost Round Bore. Special.
6 duct per duct ft.	22.0 cents	23.0 cents	1.0 cents
12 duct per duct ft.	16.4 „	17.6 „	1.2 „

This small additional cost would often be more than justified on the important lines of a large system.

10. *Duplex Conduit Construction.*

It is the practice in recent years of those who are responsible for the safety of the cables on an extensive system, to have cables routed by as many routes as are available and practical, so as to minimise the effects of burnouts in interrupting the service on the system. Where practicable, heavy conduit runs are subdivided and built part on one street and part on another so as to make this routing of cables possible, but this involves a large additional expense since it is apparent that two 12-duct runs on different streets will cost more for excavation, manholes, concrete and paving than one 24-duct run on one route.

In order to secure in a large measure the advantages of two separate runs with but very little increase in the cost, what is styled the duplex construction will be found to be desirable. This consists simply in dividing the conduit of a run into two sections, separated by a substantial barrier of concrete.

11. *Laterals.*

The connections which are made at intervals between the overhead system and the underground system of a street railway are made by means of taps or laterals extending from a manhole through a suitable duct up to the overhead conductor on the pole. These laterals,

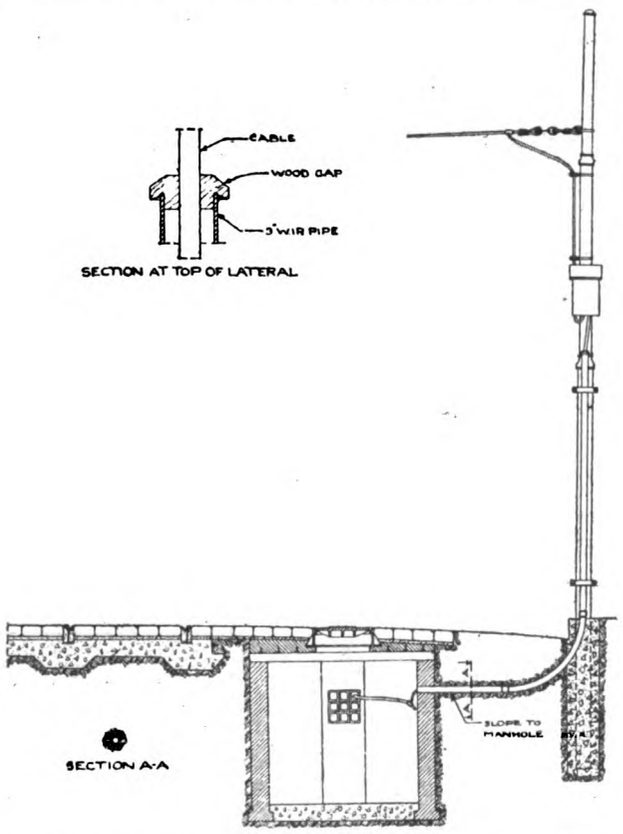

FIG. 12.—MANHOLE WITH LATERAL CONNECTION IN IRON PIPE TO THE IRON POST.

although a relatively small part of the system as a whole, may, if they are improperly insulated or improperly installed, become the weak points which are the measure of the effective strength of the whole distribution construction.

Present standards of construction have, in the main, proved very satisfactory, but there are some details which, it is believed, can be improved so as to eliminate a certain class of troubles.

It has been observed that the laterals are the points where the conditions appear to be especially favourable for the occurrence of trouble. An apparent cause of failures in the lateral connection is electrolysis, the effects of which are often to be found in the bends of the iron pipe through which the lateral connections are made. This is probably due to the fact that in a conduit system using vitrified clay ducts the sheath is usually much better insulated from the earth throughout its length than at the point where the lead sheath of the lateral tap comes in contact with the iron pipe constituting the lateral duct. This pipe, if attached to an iron pole or buried in the earth at its lower end, is usually pretty well grounded, and it has been observed that very often there is a good deal of moisture at the bend. These conditions are especially favourable to electrolytic action, which, by destroying the lead sheath, brings about, sooner or later, a failure of the insulation with its resulting burnout.

It may also be true that near the border between overhead and underground districts, the insulation at the laterals is subject to unusual strains on account of surges in the overhead system, encountering the capacity effect of the underground lead sheathed cables at these points. In any event, in order to minimize the trouble at these points it is believed that the insulating value of the lateral duct should be about the same as or better than that of the duct in the main conduit line.

The iron pipe lateral construction, shown in Fig. 12, does not provide any insulation, but, as above noted, does prove a danger point on the system. Consideration has been given to other possible forms which would provide some insulation for the lead sheath of the lateral cables.

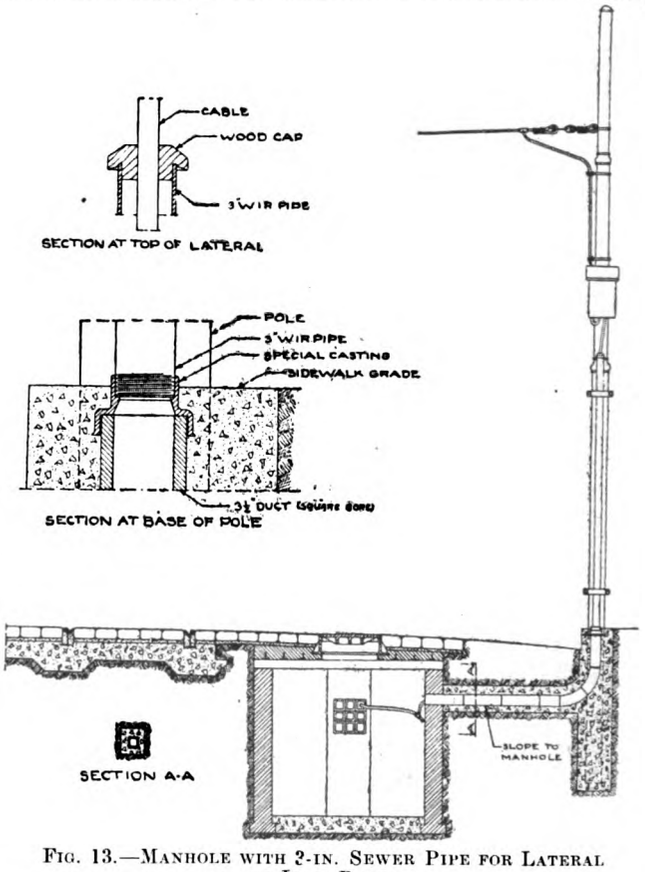

FIG. 13.—MANHOLE WITH 3-IN. SEWER PIPE FOR LATERAL TO IRON POST.

An essential of all lateral construction which is to be kept constantly in mind is the thorough protection of the conductor against mechanical injury. For the vertical portion on the pole there appears to be nothing better at the present time than iron pipe, so that all of the styles considered agree in having a vertical section of iron pipe. The other illustrations are self-explanatory, showing the 3 in. sewer pipe in Fig. 13 and 3½ in. standard duct in Fig. 14, each having a cast iron adapter to connect the sewer pipe or duct to the iron pipe of the vertical run.

Fibre duct was considered for the vertical run, but it was believed that, when used without protection from mechanical injury, the liability of injuring the conductor would be too great. So a combination of fibre to provide the insulation and iron pipe to afford the mechanical protection was designed, which is shown in Fig. 15. With this construction the insulation can be carried up the vertical run, which is not possible with the other types.

Some comparative cost estimates are given below, which as will be noted, show that the costs do not vary widely.

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The totals are as follows :—

	Iron Pipe Only. (Fig. 12)	Sewer Pipe. (Fig. 13)	Tile Duct. (Fig. 15)	Iron Pipe and Fibre (Fig. 20)
Total cost, each ..	$13.49	$11.95	$11.25	$11.36
Percentages	100	88·6	83·3	84·2

Of these styles it will be observed that the cost of the insulated types are from 11·4 to 16·7% less than the uninsulated, and that the fibre costs only about 5% more than the other two insulated types and is 11·4% less than the iron pipe. If the fibre was stopped off at the beginning of the vertical iron pipe, as is done with the sewer pipe and tile duct, its cost would be about the same as these forms. It is believed that the fact that the insulation can be carried up the vertical run is very much in favour of the use of the fibre in combination with the iron pipe.

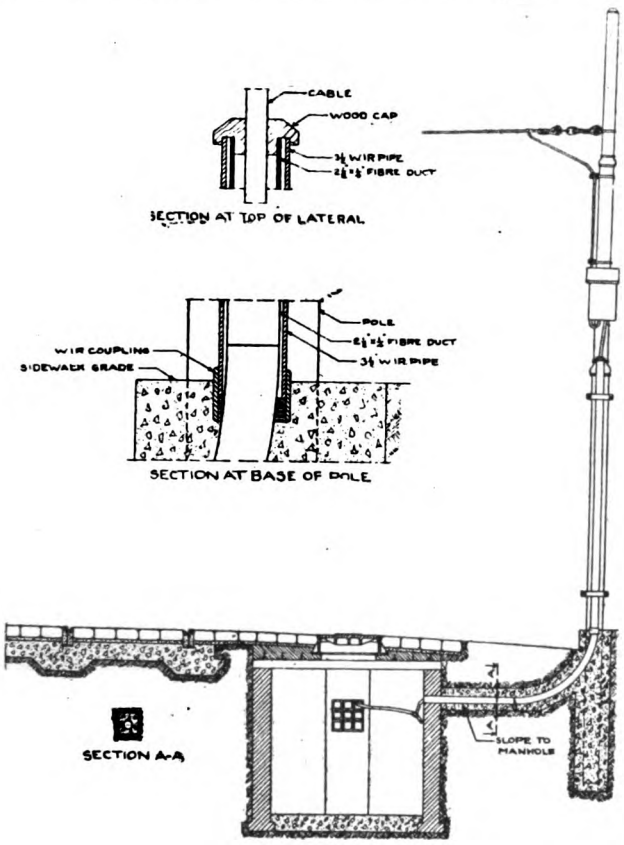

FIG. 14.—MANHOLE WITH STANDARD 3½-IN. DUCT FOR LATERAL

III. MANHOLE FITTINGS.

So far as the ideas of cable protection and isolation are concerned, the modifications thus far discussed apply more particularly to the ducts outside of the manholes. In the manholes two additional considerations are involved, viz.: the joints in the cables, and the matter of accessibility. The importance of the latter will depend upon the perfection of the cable joints and the frequency of cable troubles from other causes.

If cables are thoroughly isolated and protected so that when a burnout occurs only the defective cable is involved, then it is only a matter of securing acccess to one cable. The more perfect the protection and isolation of the cables the fewer will be the cables involved in a burnout, and hence the less will be the importance of accessibility. The degree of importance attached to preventative measures by the men in charge will determine the weight to be given to the questions of accessibility and convenience as against isolation and protection.

Various wrappings of tapes composed of a mixture of asbestos and cotton, of steel and brass strips, and coverings of plastic materials have been used. Each may be particularly adapted to some set of conditions where their use would be perfectly satisfactory, but for the conditions here considered it is believed that in the manholes the same fireproof and arc-resisting materials should be used that are used in the ducts between manholes.

12. *Fireproof Shelves.*

Sheet steel has been used for shelves in manholes, but it has been found that if the metal is thick enough to give a reasonable degree of rigidity, the cutting and fitting is difficult and expensive. In case of a severe burnout the steel, because of its good conducting qualities and relatively low melting point, tends to spread and augment the trouble rather than localise it.

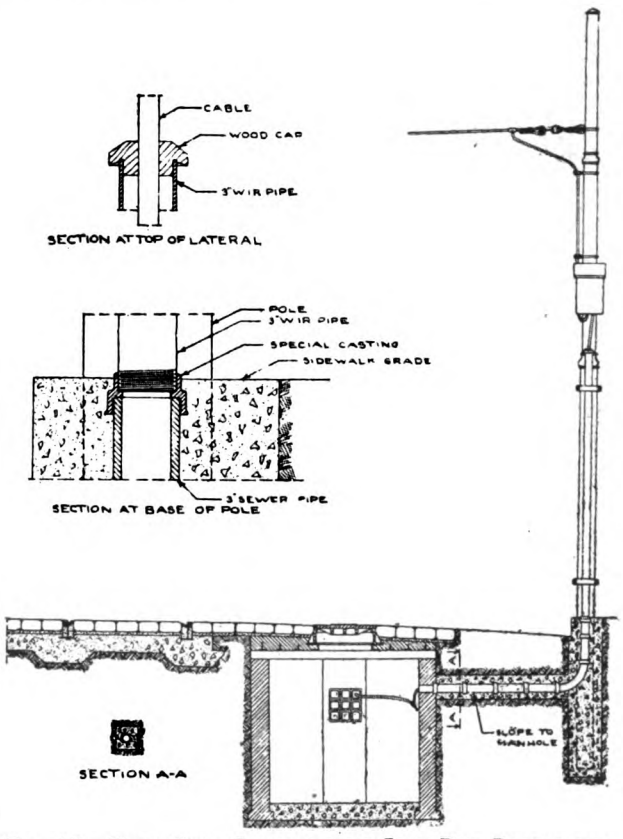

FIG. 15.—FIBRE DUCT LATERAL WITH IRON PIPE PROTECTION ON POLE.

The upper part of Fig. 16 shows a shelf construction that it is believed is less expensive, more flexible, and with the metal parts entirely covered with cement, so that it is a combined shelf and barrier. The wire mesh may be had in rolls and can be easily cut and fitted with a pair of ordinary snips, and any man who is at all familiar with the use of the trowel can, with a little plasterer's hair mixed into the cement mortar, readily lay these shelves in place. Cables are thus effectually separated into groups by a substantial horizontal barrier of fireproof material. Where only a small number of relatively unimportant cables are involved this construction gives a degree of isolation that is quite sufficient.

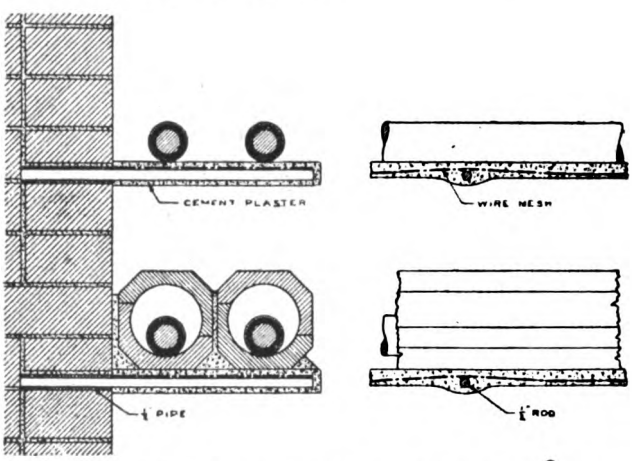

FIG. 16.—CONCRETE SHELVES IN MANHOLES ALSO SERVING AS BARRIERS. LOWER SHELF EQUIPPED WITH SPLIT DUCT.

13. *Split Duct.*

For a larger group of more important cables, the split duct construction shown in the lower part of Fig. 17, in addition to the reinforced cement shelves, can be used advantageously. Split duct is made by scoring the walls of the duct as it is excluded from the presses, so that after being burned it can be shipped to the work in whole pieces and there broken into parts for use.

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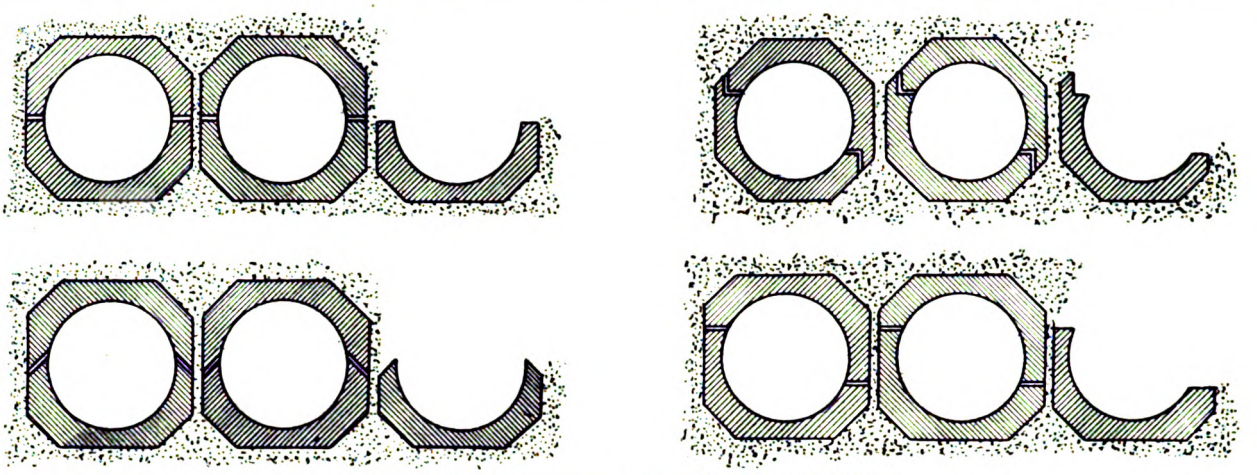


FIGS. 17-20—TYPES OF VITRIFIED CLAY SPLIT DUCTS.

The four different forms of split duct, which are available for this style of construction, are shown: Fig. 17 is the original form, with joints opposite and in a straight line between the two cables. The cement joint, however carefully made, is certain to be more or less imperfect. So with this form the weakest points in the separating wall are placed immediately adjacent and on a line which is the shortest path between the two bores.

Figs. 18 and 19 are forms designed to overcome this objetcion, but the sharp corners and angles introduced are believed to be objectionable because of the increased breakage that would result when an attempt is made to separate the two half-sections for use.

Fig. 20, which, in point of time, was the first attempt to overcome the objections to the opposite joints of Fig 17, has the straight scoring which facilitates separation, and its joints, when ducts are laid adjacent, are off-set about 1½ in. In the first lots manufactured some little difficulty was found in breaking the sections apart, but with closer attention to the dimensions of the scores this was corrected.

Short lengths and 45° and 90° bends can be secured, so that almost any series of safe bends for a large cable can be covered with the split duct.

In an average manhole the cost of this construction over that of ordinary metal racks with, say, a double wrapping of asbestos tape, will amount to about $1.00 per cable per manhole, which, considered as an insurance premium, would be small if the average distance between manholes is 350 feet, and the value of cable and connected apparatus is $2.00 per foot.

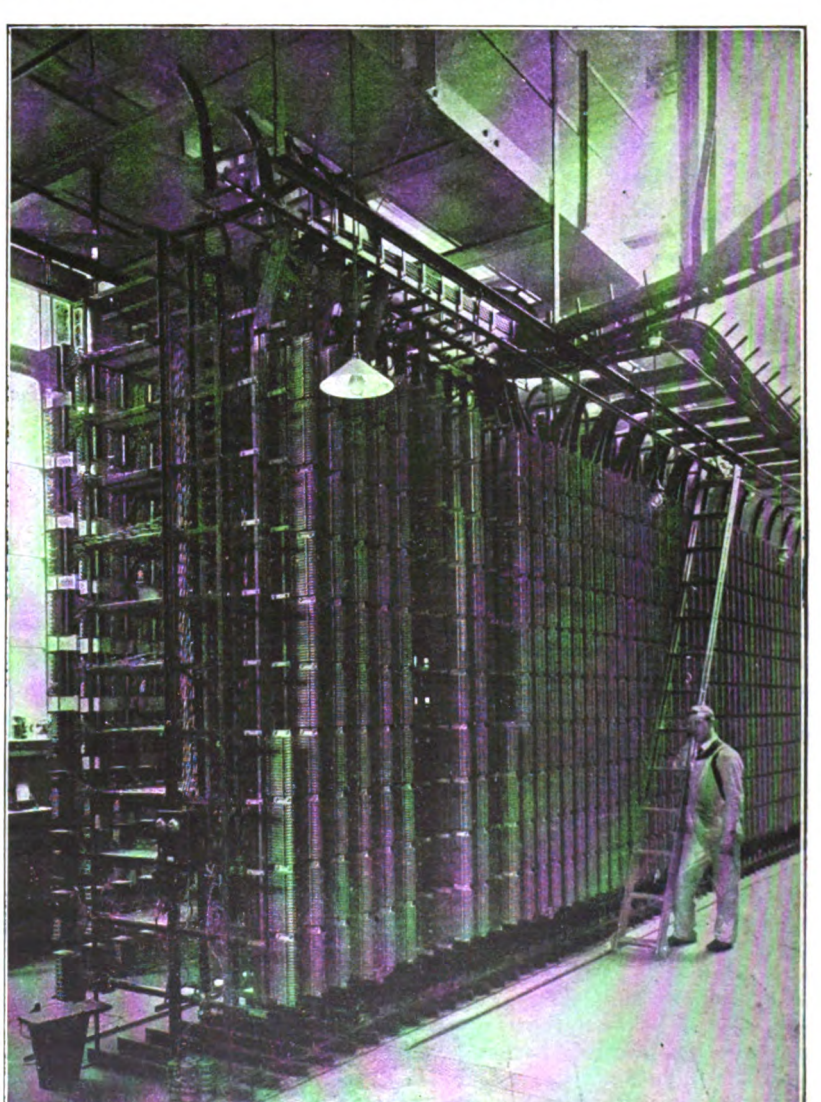
IV. RECOMMENDATIONS.

For any new underground conduit construction in any large distribution system, the following recommendations are made for the consideration of the engineer in charge of designs, and for the man who will be in charge of the cables when they are placed in service:—

1. Make absorption tests upon the ducts and include an absorption requirement in the duct specification.
2. Use square bore single duct for the standard construction.
3. Enforce a rigid adherence to a definite plan of staggering the joints.
4. Have all voids between ducts, especially at corners, thoroughly filled with mortar and concrete.
5. Order all future duct with outside corners made on not greater than a quarter inch radius.
6. Install present form of duct in longitudinal tiers, separated by a substantial layer of concrete for important lines.
7. For extra important lines of high tension lines, instal round bore duct with horizontal and vertical concrete separation.
8. Construct all lines of 16 ducts or more in the duplex form
9. For laterals, use fibre protected with iron pipe on the vertical run up the pole, and protected with concrete at the bend and on the horizontal run.
10. In manholes, use reinforced cement shelf barriers for small groups of cables of minor importance. For larger groups of important cables use the split duct in addition to shelves.

In this audience are men who have been connected with perhaps 80 or 90% of the conduit construction in this city, and naturally it was with some hesitation that I appeared before you this evening with a paper under the title given. I hope, however, that you will consider the paper in the light of suggestions made to bring out discussion, and I trust you will not hesitate to criticise any of the suggestions, especially the poor ones.

(*To be continued.*)



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DIELECTRIC STRENGTH OF OIL.

A considerable amount of excellent work has been done both in England and America in the study of what constitutes a good oil from the electrical engineer's standpoint. The latest contribution to a very interesting subject comes from Mr. H. W. Tobey, of the American Institute of Electrical Engineers. As he remarks, the fact that much of the apparatus comprised in an electric generating station depends for its safe working on the quality of the oil used becomes of almost daily increasing importance, owing to the larger units used, the higher voltages, and the general harder stress of circumstances. In spite of many trials, it is found that oil is the best substance to use, and that practically its source of supply is confined to petroleum, which must be purified by the fractional method, care being taken not to disturb the carbon, which Mr. Tobey takes to be, in the main, $C_n H_{2n} + _2$, though $C_n H_{2n}$ is also present. This is not easy to attain, as it is necessary to get rid of all water, acid, alkali and sulphur. In a long and elaborate set of tests carried out by Mr. Tobey he found that a medium oil with a specific gravity of 0·865 to 0·870 at 13·5° C., and a viscosity of 100 to 110 sec. at 40°C., had a flashing temperature of between 180° to 190° C., and a burning temperature between 205° to 215° C. A light oil tested under the same conditions, with a specific gravity of 0·845 to 0·850 and a viscosity of 40 to 50 sec. had a flashing temperature of 130° to 140° C. and a burning temperature of 140° to 150° C. In both cases the dielectric strength was the same. This at once differentiates the oils. The medium is specially suitable for such apparatus as are subject to fairly high temperatures during overload, such as self-cooled transformers, while the light oil can be used in machines where temperature is more under control, such as water-cooled transformers. Water, of course, is found to disturb largely both dielectric strength and insulation resistance. Mr. Tobey emphasises the fact that insulation resistance is not an indication of dielectric strength. Taking a transformer for testing purposes, he shows that with increase in temperature the insulation resistance falls very rapidly, while the

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200 to 250 Volts. 32 Watts.
(HALF FULL SIZE).

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PATENT

(COLLOID-TUNGSTEN)

METALLIC FILAMENT LAMPS.

BRITISH MANUFACTURE.

DELIVERY FROM STOCK.

PRICE LIST AND TERMS ON APPLICATION.

Telephone: Gerrard 1728.
Telegrams: "Bulbolite, London."

Head Office and Works:
BRIMSDOWN, M'SEX.

Imperial Lamp Works (Brimsdown) Ltd.,
SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

dielectric strength of the oil gradually increases, until conditions become constant. Slight variations of temperature hardly influence dielectric strength, though it falls slightly with falling temperature until it reaches zero Centigrade, when it again rises rapidly. As for water, he found that even 3-100ths of 1% reduces the dielectric strength to three-quarters; 1-100th of 1% of moisture reduces the strength to one-half. A good simple test for moisture is to place oil in an open vessel, heat it to the boiling point of water and hold over the vessel a sheet of cold glass, when the water, if present, will rise in a vapour and condense on the glass. As regards removal of moisture, Mr. Tobey is inclined to recommend a combination of the centrifugal machine with filter papers, as in this way both moisture and solid impurities are removed. Solid impurities are fatal, because not only do they lower insulation resistance and dielectric strength, but tend to clog. By using a medium sized cream separator of the De Laval type, with sheets of filtering material placed between the central chamber and the reservoir, Mr. Tobey was able to treat between 50 and 60 gallons per hour, and to raise the dielectric strength of a really damp oil to between 40,000 and 45,000 volts. Sulphur must be entirely eliminated, as, apart from its effect upon the dielectric strength, it attacks copper vigorously, and has even been known to sever conductors completely. Sulphur may be readily detected by slightly heating the oil and then thrusting into it a polished copper wire. As small an amount as 1-10th of 1% will turn the wire black in from 2 to 3 minutes, 1-100th of 1% in about 30 minutes, and 1-1000th of 1% in from 15 to 20 hours. In spite of all the trouble involved in getting a good oil, Mr. Tobey concludes that such good oil fulfils the ideal conditions of insulation so well that the almost universal use of oil is legitimate. The great point is that engineers should be posted as to what does constitute a good oil, and within what limits the characteristics may be allowed to vary.

COMPANIES REGISTERED.

ECLIPSE TRADING COMPANY, LTD.—Capital, £5,000, in £5 shares. Objects: To carry on the business of manufacturers of and dealers in films and apparatus capable of being used in electric or kinematograph shows or other public or private entertainments, etc., and to adopt an agreement with J. E. Morrell and E. H. Harmsworth. Private company. The first directors (to number not less than two nor more than five) are J. E. Morrell and E. H. Harmsworth. Qualification, 25 shares. Registered office, 24, Church Bank-buildings, Bradford.

TAYLOR & ROMANY, LTD.—Capital, £2,000, in £1 shares. Objects: To take over the business of builders, furnishing ironmongers, locksmiths, bellhangers, gas and hot water fitters, hydraulic, electrical and mechanical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic and other appliances, etc., carried on as Taylor & Romany. Private company. The first directors (to number not less than two nor more than five) are: C. A. Taylor and F. O. Romany. Remuneration, as fixed by the company. Registered office, 35, Little Pulteney-street, St. James's, S.W.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

THE CALCUTTA ELECTRIC SUPPLY CORPORATION LIMITED.

COSSIPORE STATION, AND SUB-STATIONS.

The Corporation are prepared to receive Tenders for the supply, delivery and erection at their Cossipore Station and Sub-stations, Calcutta, of the following:—

SPECIFICATION No. 5: MOTOR GENERATORS.

SPECIFICATION No. 6: TURBO-ALTERNATORS AND CONDENSING PLANT.

Copies of these Specifications, along with Drawings and General Conditions, can be obtained on and after August 26 from the undersigned on payment of a fee of two guineas for each Specification, which will be returned on receipt of a *bona-fide* Tender, or on the return of all the documents with a satisfactory explanation as to the contractors' inability to tender.

Tenders, which are to be written on the forms at the end of the Specification, must be enclosed in sealed envelopes, endorsed on the outside, "Electric Plant, Tender to Specification————," and sent to the Secretary of the Calcutta Electric Supply Corporation Ltd., Salisbury House, London-wall, E.C., so that they can be received by him before 10 o'clock on September 19.

The Corporation do not bind themselves to accept the lowest or any Tender, and no allowance whatever will be made for expenses incurred in the preparation of a Tender.

FRANCIS R. REEVES,
Secretary.

The Calcutta Electric Supply Corporation, Ltd.,
Salisbury House, London-wall, E.C.,
August 22, 1910.

PONTYPRIDD URBAN DISTRICT COUNCIL.

ELECTRICITY DEPARTMENT.

The above Council invite Tenders for the supply and delivery of a small quantity of low tension rubber insulated cables, with lead or fireproof covering.

Specification and particulars may be obtained from Mr. J. E. Teasdel, A.M.I.E.E., Generating Station, Treforest, near Pontypridd.

Tenders, sealed and endorsed "Cables" must be received by the undersigned on or before Monday, September 5, 1910.

The Council do not bind themselves to accept the lowest or any tender.

J. COLENSO JONES,
Clerk to the Council.

Municipal Buildings,
Pontypridd.
August 22, 1910.

APPOINTMENTS.

KENT EDUCATION COMMITTEE.

ERITH HIGHER EDUCATION SUB-COMMITTEE.

ERITH TECHNICAL INSTITUTE.

The Committee require the services of a Lecturer in Electrical Engineering for 20–30 evening lectures.

Particulars and Forms of Application may be obtained from Mr. A. T. FLUX, Education Offices, Belvedere.

Canvassing will be considered a disqualification.

By order of the Committee,

FRAS. W. CROOK,
Secretary.

Kent Education Committee,
Caxton House, Westminster, S.W.
August 23, 1910.

CONTRACTS OPEN.

HOME.

BOURNEMOUTH.—Corporation invite tenders for the supply of 450 tons tramway rails with fastenings. (Specifications, etc., (deposit £2), Mr. C. W. Hill, Tramways Manager.) August 31.

BOURNEMOUTH.—Corporation invite tenders for the reconstruction of 2½ miles tramways permanent way. (Specifications, etc. (deposit £2), Mr. C. W. Hill, Tramways Manager.) August 31.

CHELMSFORD.—Borough Education Committee invite alternative tenders for (1) supplying and fixing wiring for lighting by electricity; (2) supplying and fixing pipes for lighting by gas, at the Trinity-road Council School. (Particulars from Mr. W. H. Pertwee, architect, The Institute, London-road, Chelmsford.) August 31.

KIRKCALDY.—Corporation invite tenders for material for one mile of 3 ft. 6 in. gauge single line with four passing places as follows:—No. 1, permanent way construction; No. 2, steel poles and brackets for overhead construction; No. 3, three section pillars with fittings complete; No. 4, trolly wire and overhead line material. (Nos. 2, 3 and 4, supply and delivery only.) (Specifications, No. 1, Burgh Surveyor, Tolbooth-street; Nos. 2, 3 and 4, Burgh Electrical Engineer, at works.) August 29.

LONDON.—The County Council invite tenders for the wiring and fitting for electric lighting of the second portion of the central car repair depôt, Woolwich-road. Particulars (40s.) from the Clerk of the Council, County Hall, Spring-gardens, S.W. This amount will only be returned if a *bona-fide* tender is submitted. August 30.

PONTYPRIDD.—The Urban District invite tenders for the supply of low tension rubber insulated cables, with lead fireproof covering. (Specifications from the Electrical Engineer, Generating Station, Treforest, near Pontypridd.) September 5.

OVERSEAS.

CAIRO.—Public Works Department.—Electrical installations at Khanka Lunatic Asylum. (Particulars, Service Administratif Ministere des Travaux Publics.) October 20.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received, up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

CALCUTTA.—The Calcutta Electric Supply Corporation, Ltd., invite tenders for the supply, delivery and erection at their Cossipore station and sub-stations, Calcutta, of the following: Specification No. 5, motor generators; Specification No. 6, turbo alternators and condensing plant. Particulars from Francis R. Reeves, secretary, the Calcutta Electric Supply Corporation, Ltd., Salisbury House, London-wall, E.C. September 19.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. (Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels.) September 26.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). (Specifications, Direction des Chemins de Fer d'Outre-mer, Lisbon.) October 12.

LORENZO MARQUES.—Harbour and Railways Board.—One 10-ton and 75-ton electric cranes. (Particulars, 9 milreis gold, General Stores, Harbour and Railway Board, Lorenzo Marques, or Agency of Caminhos de Ferro de Lorenzo Marques, Johannesburg, or Direcçao dos Caminhos de Ferro Ultramarinos, Lisbon.) English translation, 4·5 milreis gold, from Caixa Geral dos Depositos, Lisbon, or from the Johannesburg or Lorenzo Marques authorities above indicated. September 5.

OSRAM·LAMPS

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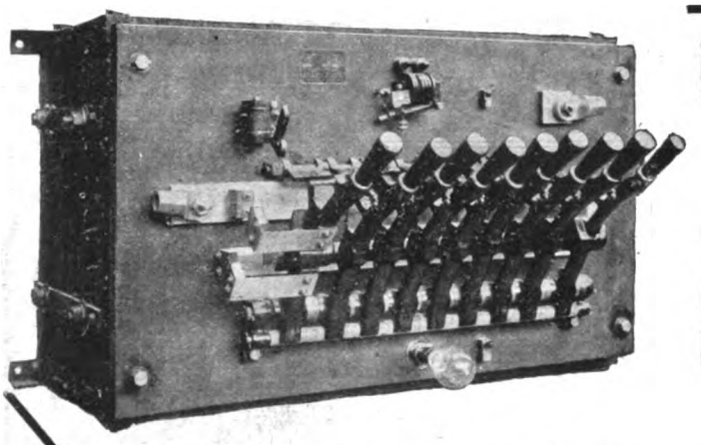

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Heavy starting currents? And can you guarantee the safety of your operators and machinery? If you cannot, you should instal

ADAMS ICRANIC
MULTIPLE SWITCH STARTERS,

for with them you combine perfect safety with absolutely efficient work.

Look at this Switch Front. The levers are so interlocked that they cannot possibly be closed in wrong order; and if current fails or overload occurs, they all open simultaneously.

PATENTS.

S. SOKAL, Chartered Patent Agent,
AND
Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.
55, CHANCERY LANE, LONDON, W.C.

THE PROPRIETOR OF THE PATENT NO. 16435 of 1905, for "Improvements Relating to Transmission Systems for Wireless Telegraphy and Telephony," is desirous of entering into arrangements by way of license and otherwise on reasonable terms, for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed, in the first instance, to—
HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
7 & 8, Southampton-buildings, Chancery-lane, London, W.C.

PLANT WANTED.

PLATINUM UTENSILS, SCRAP, LAMP TOPS.—Best prices given by DERBY AND Co., LTD., 44, Clerkenwell-Road, London, E.C. N.B.—Platinum Sold.

PLATINUM WIRE FOILS, lamp ends and scrap. Old gold, silver and mercury purchased at highest prices, by—THE LONDON REFINING & METALLURGICAL WORKS, 32, Clerkenwell-road, London, E.C. Telephone: Holborn 388.

PLANT FOR SALE.

Advertisements under this heading: Twenty-four words, 1s. per insertion; three insertions for 2s. 6d.; or each additional line of eight words, 4d.

EIGHTY MOTORS AND DYNAMOS for sale or hire.—MARTIN, 320, Witton-road, Birmingham.

FOR SALE, E.C.C. Dynamo, 135 amperes, 165 volts, in first-class order, £25; complete Switchboard for same, £7. Two 20 h.p. Alternating Current Motors, by General Electric Co., 200 volts, 50 periods, three-phase, complete £20 each.—JAMES TAYLOR, Riverside Works, Staines.

MISCELLANEOUS.

CLEANERS and BLEACHERS of Meat Cloths for Engineers and Garage use, sold in 7 lbs. bundles at 3/6, cash with orders. Carriage forward.—A. & T. INGERSOLL, 62, Waterloo-street, Camberwell, London, S.E.

EVERY ARC LAMP USER in the kingdom should read "The Application of Arc Lamps to Practical Purposes," by Justus Eck, M.I.E.E. The best book on the subject ever issued. Clearly written and well illustrated. Practically it is the "Arc Lamp Users' Manual." Cloth 8vo. 2s. 9d. net, post free, from RENTELL, Publishers, London.

MELBOURNE.—The Deputy Postmaster-General, Melbourne, will receive tenders on October 4 for the supply of telegraph and telephone insulators (Schedule No. 332). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, as above.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on October 4, for the supply of telephone material (Schedule No. 363). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. A copy of the specification may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

MOSTAR.—Municipality.—Electricity works. (Particulars from Chief Magistrate.) October 1.

SYDNEY.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to 2.30 p.m. on October 5, for the supply of 5,000 porcelain insulators. A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to each of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

WELLINGTON, NEW ZEALAND.—Tenders will be received by the Minister of Telegraphs, General Post Office, Wellington, New Zealand, up to noon on December 15, for the supply and erection of installations of wireless telegraphy at or near (1) Doubtless Bay, (2) Gisborne, (3) Cape Farewell, (4) Sumner, near Christchurch, and (5) Bluff. A deposit will be required with each tender. Copies of the specifications, conditions, and forms of tender may be obtained on application to the office of the High Commissioner for New Zealand, 13, Victoria-street, London, S.W. Copies may also be obtained by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

WINNIPEG—Board of Control.—40,000 ft. of 13,000V 3-core cable. (Specifications, Power Engineer, Carnegie Library, Deposit, $100.) September 1.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so:—

ASHTON-UNDER-LYNE: W. H. George & Sons, architects, 7 Warrington-street, Ashton-under-Lyne. Savings Bank.

BRAMLEY, LEEDS: W. Shackleton, architect, Manor House-street, Pudsey. Working Men's Club.

EGHAM: J. Worrell, architect, 19, Ludgate Hill, London, E.C. Electric theatre.

EPPING: Guardians are about to spend £11,000 on extensions at Workhouse.

ERITH: C. Wisher, architect. Working Men's Club and Institute.

FULHAM, LONDON, S.W.: J. Garrett & Son, 83, Balham Hill, builders. Combined housewifery and laundry centre, St. Dunstan's-road, for L.C.C.

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All contacts are self cleaning; sparking cannot occur because there are no sliding contacts; and partial contact is impossible with

ADAMS ICRANIC
MULTIPLE SWITCH STARTERS.

Prices and full particulars on application:

Adams Manufacturing Co., Ltd.,
106, New Bond Street, London, W.
WORKS: BEDFORD.

ADAMS

SITUATIONS VACANT.

APPLICATIONS for Appointments effectively arranged, ensuring favourable consideration. Numerous unsolicited testimonials. Expert advice. Write now.—HERBERT GREATOREX, Beechwood, Matlock.

AGENTS wanted to take up sale of "Fors" Accumulators for Bristol, Cardiff, Newport, Swansea, and principal towns in South Wales and South West England.—Apply to RICHARD PAPE, LTD., Albion House, New Oxford-street, London, W.C.

SITUATIONS WANTED.

ELECTRICAL GRADUATE of an American University, with 1½ year's practical training with the largest Electrical Company at present in America, desires position with some Technical Institution or in Electrical Laboratory. Can furnish excellent references both in England and America.—Address, Box N.Y., c/o THE ELECTRICAL ENGINEER.

FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, seeks apprenticeship with Electrical Engineer. Intelligent, good education.—S.A., c/o ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

A CAPABLE ELECTRICAL ENGINEER, shortly disengaged. Home and Colonial experience, stationary or erecting, C. I., New Rock Colliery, Stratton-on-Fosse, near Bath.

HOMERTON: Metropolitan Asylums Board, Victoria Embankment, E.C. Discharge block and staff quarters at Eastern Fever Hospital, Homerton, Grove.

LINCOLN: The city have accepted £10,000 from Mr. Carnegie for erection of public library.

MANCHESTER: Education, Deansgate. Elysian-street School, Openshaw.

MIDDLESBROUGH: T. W. T. Richardson, architect, Stockton-on-Tees. Primitive Methodist School to cost about £4,000.

OLD SARUM: J. H. Goodman, architect, Reading. Isolation hospital, cost about £15,000.

PECKHAM, LONDON, S.E.: A. J. Ware, builder, 105, Park-road, Plumstead. New premises for Hatcham Liberal Club, Queen's-road, Peckham.

ROMFORD: E. J. Little, architect, Hornchurch-road, Romford. New business premises and dwelling house. Cost about £4,500.

RUGBY: Cockerell, builder, Rugby. Palace Theatre, at a cost of £4,300.

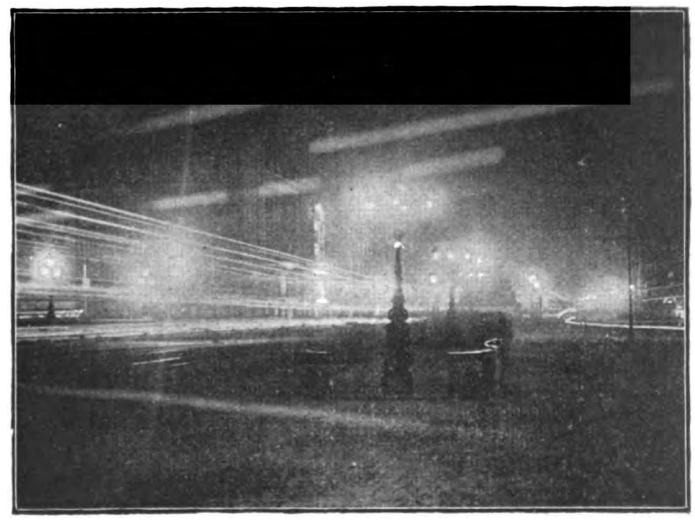
ST. HELENS: Education offices, St. Helens. New Secondary School for boys.

WEYMOUTH: Crickmay & Sons, architects, Weymouth. Elementary School for 270 boys.

NOTES.

"Osrams" on O'Connell Bridge, Dublin.

Probably one of the finest examples of street illumination by means of metal filament lamps is that of the famous O'Connell Bridge at Dublin. So well illuminated is this bridge that at night-time the blaze of light which can be seen above the house-tops from a considerable distance away, serves the useful purpose of a directing sign to travellers requiring to go in this direction. Anyone familiar with this district must be enormously impressed by the radical change for the better that has taken place since the conversion of the lighting arrangements from gas to Osrams. The present result is even more astonishing when it is realised that same is obtained by such a small number of lamps. In all, 39 100-volt 55-watt "Osram" lamps are used, these being fitted in the old lanterns which were originally put up by the Gas Company, and which have since been converted for their new use. It will, of course, be appreciated that in such a position the lamps are very exposed, and naturally encounter more than an ordinary share of rough weather. We are given to understand, however, that they have proved themselves fully capable of withstanding this rough treatment, and up to the present the corporation consider that they have behaved remarkably well. Our illustration, which has been reproduced from an untouched photograph, has the appearance of being a freak of nature, owing to the very long exposure which was necessary. The horizontal lines shown running across the centre of the picture are occasioned by the headlights of tramcars, which were continually passing up and down while the photograph was being taken. This installation is of particular interest on account of its exposed position, and again furnishes evidence that "Osram" lamps are fully capable of meeting all the necessary requirements of an outdoor illuminant.



OSRAMS ON O'CONNELL BRIDGE, DUBLIN.
This illustration has been reproduced from an untouched photograph taken at night time.

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TECHNICAL CLASSES.

City and Guilds of London Institute.

ENGINEERING AND CHEMISTRY.

There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE.

(EXHIBITION ROAD, S.W.)

A College for Higher Technical Instruction for Day Students not under 16 preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a "*School of the University of London*," and also forms the *Engineering Section of the Imperial College of Science and Technology*. The Entrance Examination includes the subjects of Mathematics, Mechanical Drawing, Physics, Chemistry, English Composition, and French or German Translation, and the Courses of Study for the Associateship of the Institute cover a period of three years. Fees, £36 per Session. Professors :—

Civil and Mechanical Engineering .. W. E. DALBY, M.A., B.Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering .. .. T. MATHER, Wh. Sch., F.R.S.
Chemistry .. .. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics .. O. HENRICI, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY.

(LEONARD STREET, CITY ROAD, E.C.)

A College for Day Students preparing to enter Engineering and Chemical Industries, and for those who have already served an apprenticeship, and also for Evening Students. The subjects of the Entrance Examination are Mathematics, and English Composition and Precis Writing. The Day Courses in Mechanical or Electrical Engineering cover a period of two years, and those in Chemistry three years. Fees, £20 per Session. Professors :—

Physics and Electrical Engineering .. .. SILVANUS P. THOMPSON, D.Sc. F.R.S., Prin. of the College
Mechanical Engineering and Mathematics .. E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry .. .. R. MELDOLA, F.R.S., F.I.C.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C.

Northampton Polytechnic Institute,

Clerkenwell, London, E.C.

ENGINEERING AND TECHNICAL OPTICS.

MECHANICAL AND ELECTRICAL ENGINEERING AND ELECTRO-CHEMISTRY.

Full Day Courses in the Theory and Practice of the above Subjects will commence on MONDAY, OCTOBER 3, 1910. The courses in Mechanical Engineering include specialization in Automobile and Aeronautical Engineering, and those in Electrical Engineering include specialization in Radio-Telegraphy. ENTRANCE EXAMINATION on WEDNESDAY and THURSDAY, SEPTEMBER 28 and 29. These courses include periods spent in Commercial Workshops, and extend over four years. They also prepare for the degree of B.Sc. in Engineering at the University of London. Fees, £15 or £11 per annum.

THREE ENTRANCE SCHOLARSHIPS of the value of £52 each will be offered for competition at the entrance examination in September next.

TECHNICAL OPTICS.

Full and Part Time Day Courses in all branches of this important department of Applied Science given in specially equipped laboratories and lecture rooms.

Full particulars as to fees, dates, etc., and all information respecting the work of the Institute, can be obtained at the Institute, or on application to

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

University of London, University College.

FACULTY OF ENGINEERING.

The Session 1910-11 begins on Monday, October 3rd.

DEGREE AND DIPLOMA COURSES.

Complete Courses of study extending over three years are arranged in Mechanical, Electrical, Civil and Municipal Engineering.

Students desirous of entering the Faculty of Engineering with the view of taking a full Degree or Diploma Course must have passed the Matriculation Examination, or some other examination accepted in its stead.

SPECIAL COURSES.

Students who have already undergone a partial training elsewhere, and who have attained a sufficient standard, may enter for a Course occupying less than three years, and may obtain a General Certificate of Engineering after not less than two consecutive sessions.

POSTGRADUATE WORK AND RESEARCH.

Graduates in Science or Engineering or Students who have done the work equivalent to a degree, may be admitted to Special Courses of Study, or to prosecute original research.

ADMISSION.

Intending Students should communicate with the Provost as soon as possible, and in any case not later than SEPTEMBER 20th, and should send a full statement of their previous training.

Full particulars may be obtained on application to the undersigned.

WALTER W. SETON, M.A., *Secretary*,
University College, London
(Gower Street).

THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE, GLASGOW.

SESSION 1910-11.

Day Classes begin TUESDAY, September 27. Evening Classes begin Thursday, September 22.

The DIPLOMA of the College is granted in the following departments:—Civil Engineering, Mechanical Engineering, Electrical Engineering, Mining, Naval Architecture, Chemistry, Metallurgy, Mathematics and Physics, Building, Textile Manufacture.

The Courses of Study for the Diploma usually extend over Three Sessions. The average fee per Session is £12 12s. Holders of the Diploma are eligible for the Degree of B.Sc. in Engineering of the University of Glasgow after attendance for at least one Session upon prescribed University Classes. In conjunction with the Glasgow School of Art a Course for a Joint-Diploma in Architecture has been arranged.

The preliminary examination for Candidates for the Diploma begins on September 19. Names of Candidates must be lodged not later than September 1.

New and well-equipped Laboratories have been provided in the Departments of Physics, Chemistry, Technical Chemistry, Dyeing, Metallurgy, Mechanics, Motive Power Engineering, Electrical Engineering, Mining, Textile Manufacture, Biology, Bacteriology and Navigation, and facilities for research are afforded.

Calendar (price by post, 1s. 4d.) and Prospectus (gratis) will be sent on application to the Secretary.

University of Durham.

Armstrong College, Newcastle-upon-Tyne.

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SESSION 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

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Water Tube Boilers.

Among the recent large contracts booked by Messrs. Clarke, Chapman & Company, Ltd., of Gateshead-on-Tyne, for their Woodeson patent water tube boilers, are the following: Large installation of boilers for extensions to the generating station at Devonport Dockyard, this being a repeat order for this type of boiler received from the Government during the last 12 months. Two large boilers for Messrs. W. Sommerville & Sons for their paper works. Four boilers for utilising the waste gases from coke ovens for Messrs. Nunnory Colliery Company. Four boilers for utilising waste heat from re-heating furnaces for Messrs. Wm. Cooke & Sons. Four large boilers for Messrs. Sir B. Samuelson & Sons, Middlesbrough, to work in connection with blast furnace gases. One boiler to utilise the waste heat from re-heating furnaces for Messrs. Brown, Bayley & Company. One large boiler for Luton Corporation. One boiler for Whitehaven Colliery, this being the third repeat order for this company. These, together with a large number of boilers booked during the previous few weeks for various parts of the country are keeping the boiler yard well employed, and which speaks well for the success of the Woodeson boiler. It will be noticed that all the above orders are for this country, but there are several large orders in hand for continental and other foreign countries.

Accumulators.

Messrs. Armstrong & Company, of Faraday Works, Twickenham, have built up a very large business in the supply of their accumulators, which they make in a great variety of patterns and in many sizes. These include small and large accumulators in glass cells, portable accumulators in transparent celluloid cells, and large ones in lead lined wood boxes for lighting, traction and other purposes. As seems fitting, considering the locality of the factory, Messrs. Armstrong pay particular attention to accumulators for boats, and have recently introduced an excellent horizontal type, in transparent celluloid cases. Of miniature sizes they have numerous patterns for pocket use, and others for serving portable lamps and torches, surgical pocket and portable reading lamps. By the way, Osram lamps of various designs are used in most of the Armstrong specialities. The 26-paged illustrated catalogue is a revelation as to the manifold forms of electrical accessories; it is one of the things with which every dealer should be provided.

Chimney Shaft Repairs.

The Steeplejack & Engineering Company, of Castle Boulevard, Nottingham, have just secured an important contract in London. They have been instructed by the City of London Electric Lighting Company, Ltd., to carry out extensive repairs to two chimney shafts at their Bankside generating station.

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Australian Electrical Imports.

OFFICIAL RETURNS.

An official return of imports of electrical appliances into the Commonwealth, and of Inter-State transfers, for the year 1909 has been issued, and is given below :—

Table showing actual and relative values of exports of various countries to Australia.

Class a—accumulators, arcs and carbons, cables, instruments, tapes; b—dynamos and motors below 200 h.p.; c—dynamos and motors over 200 h.p.; d—fittings as switches and fuses; arresters; e—generators for direct coupling to turbines (steam); f—rheostats and controllers; switchboards (except for telephones); g—electric and gas appliances N.E.I.; h—telephone apparatus.

	Class a. per cent.	Class b. per cent.	Class c. per cent.	Class d. per cent.	Class e. per cent.	Class f. per cent.	Class g. per cent.	Class h. per cent.	Total. per cent.
United Kingdom	73	51	36	58	89	41	49	63	60
Germany	19	14	30	26	11	43	31	7	17
U.S.A.	5	30	31	14	—	12	10	4	15
Others	3	5	2	2	—	4	10	26	8
Total value	£222,500	£235,500	£32,300	£29,500	£29,200	£26,500	£126,100	£115,900	£817,400

The large percentage value of "Others" in Class H is due to Swedish telephone exportations.

Table showing actual and relative value of Australian imports into the different States, thus indicating their comparative importance as consuming centres.

State.	Class a. £	Class b. £	Class c. £	Class d. £	Class e. £	Class f. £	Class g. £	Class h. £	Total.
New South Wales	89,000	151,000	17,900	14,500	19,450	14,400	61,200	24,000	48%
Victoria	83,000	31,500	3,900	5,700	200	3,500	33,900	58,400	27%
Queensland ..	11,000	9,500	—	400	4,400	500	7,600	5,600	4·7%
South Australia ..	21,000	33,000	8,400	7,000	950	6,300	13,000	14,700	12·8%
West Australia ..	14,000	7,500	2,000	1,000	3,200	2,000	9,100	10,500	6%
Tasmania	3,000	2,300	—	300	—	50	1,300	2,700	1·5%

Table showing the actual and relative values of goods transferred by each State to all the others. (This indicates the importance of each State as a distributing centre.)

State.	Class a. £	Class b. £	Class c. £	Class d. £	Class e. £	Class f. £	Class g. £	Class h. £	Totals. £	per cent.
New South Wales	15,400	14,600	1,400	2,020	30	650	15,400	2,050	51,450	51
Victoria	28,300	6,000	630	1,200	30	1,460	10,000	2,000	34,300	34
South Australia ..	4,600	1,500	630	300	900	950	1,600	500	10,900	11
Q., W.A., T. ..	2,000	1,200	90	50	400	50	1,000	500	5,300	5
Total	£50,300	£23,300	£2,750	£3,570	£1,360	£3,050	£28,000	£5,050	£101,950	—

Note.—Of these there are included £880 of Australian manufacture.

In 1909 Australia exported electrical goods to New Zealand as follows :—

New South Wales, £14,000. Victoria, £9,000.

Table showing the number of towns and cities in Australia with a population of over 1,000, thereby exhibiting possibilities in town lighting. (Only a very small proportion have electrical supply.)

Population.	New South Wales.	Victoria.	Tasmania.	South Australia	Queensland.	West Australia.
Above 1,000, under 2,000 ..	34	35	5	—	13	1
„ 2,000 „ 3,000 ..	25	13	1	5	14	4
„ 3,000 „ 5,000 ..	19	13	1	1	7	6
„ 5,000 „ 10,000 ..	5	3	—	1	7	1
„ 10,000 „ 15,000 ..	1	1	—	—	5	2
„ 15,000 „ 20,000 ..	—	1	1	—	1	1
„ 30,000 ..	1	2	1	—	—	—
Capital population	500,000	550,000	37,000	181,000	140,000	51,000
Total population	1,700,000	1,300,000	183,000	410,000	510,000	280,000

CATALOGUES AND PRICE LISTS.

Messrs. Donovan & Company, Birmingham: two four-paged circulars, (1) Electric Light Accessories, (2) Barwick Switch Gear.

Messrs. Clarke, Chapman & Company, Ltd.: Pamphlet No. 7, "General Information Regarding Water Tube Boilers for All Purposes," illustrated.

Messrs. Bruce Peebles & Company, Ltd.: Illustrated pamphlet, "Peebles' Clyde Patent Capstans," with electric motor attachments.

Krupka & Jacoby: Illustrated price list of Dr. Lessing's carbon brushes in different patterns and qualities for various purposes, and carbon contacts.

Reflector Syndicate, Ltd.: Illustrated price list of the Cowper-Coles' mirrors for lamp reflectors.

WIRELESS FOR SARAWAK.

Rajah Brooke, of Sarawak, is making inquiries as regards wireless telegraphic installations. He is desirous of placing his capital in communication with Singapore, as well as providing a receiving station for messages from ships at sea.

PRINTING PRESS CONTROL.

The Witton-James system of printing press electric control has been acquired by Witton-James, Ltd., of Midland Bank-chambers, Queen Victoria-street, E.C. Mr. H. V. James remains as managing director. The company will now take up electric power work generally, but will specialise in connecting with rotary printing press, textile machinery and kindred schemes.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

A very curious sidelight has during the last few days been thrown upon the question of the safety of electricity in collieries. Nothing is so powerful as a comparison, and a serious pit fire which has taken place at the Eden Colliery, near Leadgate, in the County of Durham, indicates that other sources of power besides electricity can be the occasion of much damage. In this instance an oil engine was installed about a mile inbye, in the main coal seam. It is believed that the fire originated owing to the ignition of some paraffin oil which had been inadvertently spilt near the engine. The fire thus caused spread to some timber in the vicinity, and owing to the heavy fumes it was impossible to reach the scene of the outbreak. Workmen wearing smoke helmets had to be withdrawn exhausted and medically treated; many heavy falls took place, and the fight, superintended by Mr. F. O. Kirkup and others, took 26 hours before the flames were subdued. Fortunately, the men were out of the pit at the time, and the mine was not a fiery one, or the damage might have been more serious; but the pit, employing over 200 men, was laid idle, and the incident is a warning against employing flame-motors inbye.

Transport Difficulties in Collieries.

While upon the subject of colliery work, it is interesting to refer briefly to the strike at the Auckland Park Colliery, County of Durham, by which about a thousand workers were laid idle, and which turns upon transport arrangements underground. It appears that an earlier finish to work on the day previous to the Durham Miners' Gala was desired by the men, and by some inadvertence the "sets" for the men were not sent to the workings far inbye, which meant that the men had to walk to the pit-shaft. A strike, therefore, took place. The moral of the incident to electrical engineers is that now the Eight Hours' Act has come into force, the time taken in transport from the workings to the shaft is of prime importance, and the institution of light, quick-running haulages for the pitmen should follow.

Developments at Derwenthaugh.

It is proposed by the North-Eastern Railway Company to develop coal-handling facilities in the upper reaches of the Tyne by the building of new staithes somewhat to the west of those already existing at Dunston. It is estimated that the new staithes, for which contracts will shortly be required, will be capable of dealing with an extra two million tons of coal per annum. The North-Eastern Railway Company have been very enterprising in the electrical equipment of their existing staithes on the Tyne, at Blyth, and elsewhere, so that it may be assumed that there will shortly be an opportunity for electrical manufacturers.

Newcastle-on-Tyne Corporation Tramways.

Some very interesting figures have this week appeared in the local press regarding the Newcastle Corporation Tramways undertaking. It is estimated that by the various schemes now inaugurated a net additional income of over £6,000 will be obtained. Of this, £3,500 is to be produced by advertisements on the tram-cars, while at the present rate, the system of charging a penny per parcel carried, referred to in previous notes in this column, is expected to yield about £2,500. On one Saturday only 3,033 parcels were carried. A third increase of revenue is found by the system of halfpenny stages on the last outward half-stage of terminal routes, special fares to the coast and to Gosforth. The question of extensions is receiving attention, a sub-committee of the Tramways Committee having inspected various routes where an extension to the system would be beneficial. The trouble referred to in last week's notes between the employees and the committee has advanced a stage further, the men being now desirous that the committee should meet a deputation including the President and General Secretary of the Newcastle and District Tramway Workers' Union. They have also adopted a resolution calling for a general meeting to protest against the "unconstitutional action" of the Tramways Sub-Committee, and to decide on steps to ensure their right as trade unionists.

Other Tramway Systems.

Progress can be reported on other tramway systems and schemes in this area, which promises to be one of the most important, as regards transport facilities, in the kingdom. The local manager of the Tynemouth Electric Traction Company has been in communication with the Whitley and Monkseaton Urban District Council regarding the scheme, mentioned in this column, for extending the Whitley Bay car service to Blyth, and hopes are entertained in some quarters that this scheme will proceed favourably. The Gateshead and District Tramways Company are considering the question of the extension of their service through Hebburn, a project which has the support of the Hebburn District Council, and to which it is expected the Councils of Jarrow and Felling will also agree; while at Wrekenton preparations are being made to extend the tramway service into that area.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

Remarkable progress is being made at the Smethwick Power Station (connected with the Birmingham & Midland Tramways, Ltd.), in the application of electricity in various industrial uses. Probably the most important application of electricity for smelting purposes in the district is that by this department to the works of Albright & Wilson, Oldbury. The district has been described as the world's centre for the supply of phosphorus, and the firm of Albright take from the Power Station about 3,000,000 units in connection with one of their largest furnaces, utilising 300 kw. Several very large works have lately been connected. Among others, Messrs. Archibald Kenrick & Sons, of Spon-lane, West Bromwich, are applying electricity for general engineering purposes. They are commencing with about 250 h.p. of three-phase, 25 periods and 400 volts. Messrs. Hunt & Company, of the Brades Steel Works, are making extensions which will require further supply to the extent of 150 h.p. At this establishment the current is conveyed to the extent of 5,500 volts by an overhead wire which crosses the canal. The power is at present being used mainly for shop machinery of various kinds, but will probably be utilised shortly for the driving of mills. Other firms supplied are Messrs. F. R. Simpson & Company, of the Park-lane Ironworks, who are taking 200 h.p.; Messrs. Evered & Company, who are introducing 150 h.p. for the cold rolling of metals; and Messrs. E. G. Wrigley & Company, Ltd., makers of drills, gears, etc., who are taking 90 h.p. These rapid extensions have compelled the power station to instal a 1,000 kw. turbo for immediate requirements until the 2,000 kw. Parsons' turbo-generator in course of installation is completed.

Greater Birmingham "Hung Up."

The inconclusive position of the Greater Birmingham scheme, which has passed the Committee of the House of Commons, and will receive final settlement before the House of Lords at the Autumn Session, has placed the local authorities, and especially the electrical departments, in an awkward position. This especially applies to the Handsworth authority, which requires to anticipate the provision of increased electrical power for running the tramways when

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they pass out of the hands of the tramway company into those of the Council on June 11 next year. Till the matter has been finally decided, nothing can be done, and in particular the obtaining of the requisite loans has necessarily been postponed. As the Birmingham scheme has not been successful in its inclusion of Handsworth for Poor Law purposes, this has stimulated local opposition in the hope that the inclusion of Handsworth in the city may fail to secure Parliamentary sanction. In the meantime, the Handsworth department, which is thoroughly alive and up-to-date, is rapidly progressing. Household installations are on the increase, and as last year saw a rise in this respect of 50%, it is quite likely that this rate of progress will be maintained during the coming year. An important installation now in progress is the one at the new King Edward's Girls' School, Handsworth, which is to be entirely lighted, as well as ventilated, by electricity. Four motors are to be supplied, comprising two 8 h.p. and two 5 h.p., for driving the electrical fans. All the rooms are to be ventilated by air ducts worked on the suction system. The scheme, which is somewhat elaborate, provides for ducts leading down from each room to the basement, where the fans are situated. Other large schools in the district have applied electricity to the same purpose, but the Handsworth King Edward's School will introduce a new method of application.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

Certain stations in the smaller Lancashire towns have been taking advantage of the local "wakes" or summer holiday week to increase the capacity of their plants. This week the Radcliffe Corporation station are putting in a new 300 kw. generator and other plant to meet the growing demand for electricity in their area. A few months ago the Lancashire Power Company made great efforts to compete with the Corporation on their own territory, on the grounds that the Corporation were not giving an adequate supply. At present the Power Company are supplying under a lease from the Corporation three large consumers within the area. What future extensions will take place are not yet decided. It is interesting to note, however, that the load has increased about 50% roughly during the past year.

Progress at Heywood.

Here, again, good progress is recorded, although the cotton trade, on which the town mainly depends, has been depressed during the past year. The latest extension, put in some months ago, was a 500 kw. E.C.C. generator and Browett's engine. New boilers have also recently been installed. Advance is being made with the lighting load and even a little "cottage" property has been wired, though this experiment suffered somewhat from being on a length of faulty mains. The people, being of the old-world conservative type, were only too pleased to find something to grumble about, and put down the trifling interruptions in supply as quite outbalancing any virtues the new light might possess. However, new mains practically throughout the town have just been installed by W. T. Glover & Company, Trafford Park, so no further trouble is anticipated on this score. There are some four miles of tram route within the area (on the line between Bury and Rochdale), and this takes a good proportion of the station's output. There is also a good load in small and medium-sized motors, although the power rate is very high, being 2d. per unit, with a sliding scale. As most of the mills have comparatively new steam plants, there is no great prospect of these being scrapped just yet. There are, however, some mills with engines nearly ready for the scrap-heap, and on these the power station is casting hungry eyes. Most of the mills, however, have small motors on the mains as auxiliaries to their engines, particularly in odd corners of the works, where transmission is difficult, or overtime wanted.

Current Items.

The Stalybridge, Dukinfield, Rossley and Hyde Joint Electricity Board are justly very proud of their extremely low costs. They are now sighing for further fields of conquest, and think that Ashton (a neighbouring town, which, as I mentioned some time ago, is now settling plans for a new £48,000 extension) might buy its additional supply in bulk from them cheaper than generating its own. I understand a meeting of the committees or their representatives is to be held to consider the question.

New Mills are extending their gas plant and have just got permission to borrow £3,400 to do so. £1,500 of this is for a water gas plant. It is thought this is the first application made for such a plant. The gases will be mixed together in the proportions allowed. The application is interesting to electrical engineers as showing a cheaper arrangement than usually adopted by their gas competitors. The water gas plant will save about £4,000, which would be the cost of the new holder needed for a coal gas extension.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

Messrs. C. J. Thursfield & Company, of Birmingham, seem to command a growing market in Scotland. Their representative in Glasgow, Mr. James Orr, of 68, Gordon-street, finds that his firm's wares increasingly commend themselves to architects and contractors. Mr. Orr has been specially successful in connection with church lighting, having supplied the fittings for no less than 62 churches in Glasgow and district during the last three years. In connection with church lighting, it is interesting to note that the Glasgow Corporation Electricity Department have now over 200 churches connected to their mains. These take their energy through a total of 339 meters, consume per annum over 200,000 units, and bring in a bill of about £2,600. This means an average annual bill of £13 for each church, which is surely equal in price to anything done by the competitive means of illumination!

'Phoning from Railway Trains.

In connection with the system of wireless telephoning from moving trains, recently invented by Mr. Hans von Kramer, of the General Electric Company, the Scotch railway companies are said to be considering the possibilities of applying Mr. von Kramer's invention for their longer journey routes. Interrogated with regard to the matter, however, a prominent official of the Caledonian Railway Company was not inclined to be hopeful with regard to the early adoption of this accession to the convenience of long journey train service.

Wiring Work.

Enquiry elicits the information in various quarters that the autumn season is likely to be a good one for the wiring contractors. One of the oldest firms in Glasgow, who during the past two years have suffered more than most from the results of the past two years' depression, are in the happy position of being able to report not only a large number of enquiries coming in, but a fair body of wiring work on hand. It was pleasing to note in the east end of Glasgow the other day that Messrs. Meighan & Sons, electrical contractors, were busied in a large drapery establishment wiring the premises for metal filament lamps where Humphrey's gas lamps have hitherto been in use.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Some interesting researches have been made by A. Heller as regards the running expenses of electric and petrol driven 'buses respectively. These experiments are also of interest apart from considerations of comparison. The electric 'buses were built by the Austrian Daimler Company,

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with rear driving motors, deriving their current from an 80-cell secondary battery having a capacity of 292 ampere hours when giving a 59-ampere current.

During the five months over which the experiments lasted the 'buses did 86·4 km. (say 54 miles) daily without re-charging and without any serious difficulties of any kind, and without lowering the capacity of the battery. So far as these considerations go, there is not much to choose between the electric motor 'bus and the petrol motor 'bus, but this cuts both ways, and the superiority of the electric 'bus in smooth noiseless running, and particularly in the avoidance of the unwholesome and disagreeable smelling exhaust which seems to be inseparable from the use of a petrol 'bus, should surely play an important part in deciding the preference.

Electric Drive in Ironworks.

The superiority of electric motors as accessory machines at ironworks is now generally admitted, even for rolling mills. At the same time in erecting new plants, or in transforming old ones, the introduction of electric motors must depend on the particular circumstances of the case. That these are highly complicated is obvious, but an extremely important contribution to the literature of the subject has been made by M. Riecke in *Stahl und Eisen*. M. Riecke investigated the following cases. (1) Dynamos driven by gas-motors, reversing rolls by steam-engines, direct rolls by electric motors. (2) Dynamos driven by turbines, otherwise electric drive. (3) Gas motor power at the central station, electric motors elsewhere. (4) Central stations working partly with gas motors and partly with turbines. The following table shows the results for a yearly output of 386,000 tons of pig-iron from the blast furnaces, and an output of 360,000 tons of steel.

No.	Heat consumption in W E Per hour.		Per year.		Cost of Plant.
1	72·86	10/6	389,560	10/6	£200,000
2	73·58	10/6	424,704	10/6	150,000
3 (1-2)	43·8	10/6	252,800	10/6	255,000
4 (2-3)	58·69	10/6	338,752	10/6	210,000

This shows that for coal prices up to 18 marks, say 17/6 per ton (2) is preferable. At a coal price of 13 marks (2) is as cheap at (3), independently of saving in labour, lubrication and repairs. At prices over 13 marks (3) gives better results. If the price is between 15 and 18 marks (4) is to be preferred, at least for the stations from which the figures were obtained. They were working with five gas dynamos each of 2,000 h.p. and two steam turbines each of 6,000 KVA. M. Riecke considers the average steam consumption one ton of iron to be 2½ tons (including losses by condensation) when the rolls are driven one way by good steam engines. The amount of steam falls to 1·2 tons with electric drive of such rolls. In a case where seven steam engines running without load consumed 22 tons of steam, the equivalent electro-motors required only 235 kw., corresponding to 2 tons only of steam.

New Electric Railway.

During the present summer the electrically driven rope railway up the Niesen, a mountain on the south of Lake Thun, has been opened for traffic. The mountain is 7,740 ft. high, and the line starts at about 5,500 ft. below the summit, ending within two minutes walk of the inevitable hotel on the top. The journey up takes 50 min., the average incline is about one in two, and the total length of the railway is about 2¼ miles. The driving power is supplied by a three-phase alternating current of 4,000 volts and the motors hauling the rope are of 85 and 65 h.p., the cable is an inch and a half in diameter with a tensile strength of 200 tons, although the maximum working strain on it is about 15 tons only. The carriages are designed to carry 40 passengers and are amply provided with brake power, while they are in telephonic communication with the engine houses (there is one at the foot of the mountain and one half way) throughout the journey either way.

Company Affairs.

A new company has been formed with the title Oberrheinische Kraftwerke Aktiengesellschaft, Mulhausen in Elsass. The capital is 20 million marks. The promoters are the town of Mulhausen, the Elektrische Licht und Kraft anlagenaktiengesellschaft, of Berlin, the Zurich Bank fur Elektrische Unternehmungen, and also Justus Breul, of Grunewald-Berlin, and Kark Zander, of Zurich. The object of the undertaking is to supply electric power for all purposes to Alsace-Lorraine and Baden. The power will be derived from turbines driven by the Rhine.

For the year 1909–10, the second year of its existence, the Wolframlampen Aktiengesellschaft has begun to prosper, in spite of the partial strike, without which the results would undoubtedly have been even better. The output increased more than enough to compensate for the diminishing rate of profit. Instead of the net loss of 203,830 marks for 1908–9, there was a net profit of 42,974 marks. The gross takings were 2,477,134 marks. It is, of course, impossible to yet declare a dividend.

Hot-Wire Voltmeter.

The Felten & Guilleaume Lahmeyer Werke A.G. has just marketed a hot-wire voltmeter associated in the same case with a small transformer. The new instrument requires but little energy, and only about one watt for tensions up to 130 volts. This excellent result is due chiefly to the high efficiency of the transformer, and its small current when there is no load. The resistance of the primary coil of the transformer is 615 ohms at 130 volts. The hot-wire is, of course, in circuit with the secondary coil. By inserting suitable known resistances the voltmeter can be applied to the measurement of still higher tensions, without any sensible increase in expanse. With 3,000 volts the consumption of energy does not exceed 2½ watts, a quantity far less than that required for an ordinary hot-wire voltmeter, where a big resistance has to be used instead of a transformer. There are two further advantages secured by combining a transformer with the meter. One is that disturbing effects due to heat are avoided. The other is that the new voltmeter is far less dependent on change in frequency.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Electrification of mines is coming steadily to the fore here, where so many mines are being worked practically without profit, owing to the heavy costs involved. Mr. O. B. Willcox, Vice-President of the Central Colorado Power Company, made this the subject of his discourse before the Electric Club of Denver. Electrification, he declared, meant very substantial economy. He stated that a number of mining companies which had taken electric power found that their saving under this head ranged from 25 to 50%. Although this statement has called forth some protests, the figures are right enough, as experts know. Indeed, some are looking forward to the re-opening of abandoned mines on the slopes of the Rockies, mines which had been closed down owing to the excessive expenses of working.

Electricity Direct from Coal Mines.

An interesting example of securing cheap electric power for mining and other purposes occurs in Texas, where, in the centre of a coalfield about 36 miles above Laredo, on the Rio Grande, a syndicate are taking steps to erect a generating station, the idea being to use coal screenings direct from the pits' mouths for fuel. The energy will be transmitted to Laredo, Carrizo Springs and Cotulla, in Texas, and to a number of places in Mexico, including Monterey and Lampazos. The Uvalde and Crystal City Railroad, which is now operated by steam between Uvalde and Carrizo Springs, is to be extended to the coal fields, where the power plant will be located, and will be converted to electric traction, energy to be furnished by the proposed plant. The extension of this road will be about 35 miles long, making in all about 110 miles of track that will be operated electrically. It is expected that energy will be

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urnished for irrigation pumping on both sides of the Rio Grande for a distance of 100 miles along that stream. The initial equipment of the plant will be rated at 50,000 h.p. A Mr. H. A. Stucky is the president of the syndicate.

Street Rails.

The American Street and Interurban Railway Engineering Association have been meeting the chief manufacturers of rails to discuss the drawing up of a workable specification. It is recognised that hitherto main-line railway practice has been the guiding principle, while as a matter of fact street railways demand special attention. In main line work it is necessary to have a hard rail to resist wear, but one, above all, which is not brittle, as owing to the high speed, and sudden impact, brittleness would mean splitting of rails and disaster. Therefore a rail for steam lines must have a high carbon contact, with the lowest possible phosphorus percentage. That means an expensive rail. With street and interurban work, it is a matter of extreme hardness, to resist the constant heavy traffic. But there is practically no shock, and comparatively low speed, so brittleness is not of such consequence. The Association, however, seems inclined to insist on a high carbon and low phosphorus and sulphur contents. The carbon figure is placed at an average of ·77, with a minimum of ·72 and a maximum of ·85, the phosphorus being kept at ·03 and the sulphur at ·06. Manufacturers are quite willing, but point out that they will have to demand higher prices. Statistics of the railroad companies clearly show that such a costly rail is by no means necessarily, and some engineers, both inside and outside the Association, are looking for a compromise.

Central Station Men and Manufacturers.

Co-operation between central station men and manufacturers formed the topic for discussion at the last meeting of the Electric Club of Chicago. Mr. Homer Niesz, President of the Cosmopolitan Electric Company, Chicago, opened the ball by dwelling upon the enormous amount of plant required by central stations for their own use and for sale to their customers. He thought that the electric show, held annually, offers excellent opportunities for both to come in close touch with each other and work together for the good of the industry. Mr. E. L. Callahan said that the manufacturers' travellers should act as guides, philosophers and friends to the central station men, not only endeavouring to sell them goods, but showing how in their turn they should set about selling them.

Maintaining Prices.

According to Mr. S. F. Dibble, of the General Electric Company, Chicago, an important point was to educate the central stations up to the necessity of maintaining prices of electrical apparatus. Central stations are bound to incur the ill-will and, consequently, the more or less open opposition of the local dealers if they follow the practice of selling appliances below cost. The sale of a motor or other apparatus at less than the established price is, he held, a confession of weakness on the part of a sales organization. The central station naturally and logically occupies the dominant position in the sale of current-consuming devices as well as in the sale of current, for the public will accept the word of the central-station man as to the merits of a piece of apparatus in preference to that of the dealer, and with this great advantage, the speaker maintained, that it is not only unnecessary, but distinctly ill-advised, for a central station to demoralise prices, thereby antagonizing the dealer directly and the public indirectly. Taking up matters from the manufacturers' standpoint, Mr. Dibble said that it was obvious to the central-station man that his interests and those of the manufacturer are identical. The manufacturer is producing the best goods he can, and is supplying it at a price which represents only a fair profit; he is, furthermore, actively assisting the central station in the sale of apparatus by supplying attractive advertising matter and the personal assistance of trained specialists. The central station is co-operating by maintaining new business departments, carrying stocks of appliances, etc., etc. Mr. Dibble said that this co-operation is vital to the success of both, and it should be augmented wherever possible. He said that in no way can this be done as effectively as by the maintenance of proper prices by the central station.

The Contractor.

Mr. Jamieson, of the Commonwealth Edison Company, Chicago, emphasised that central station men should have a commercial training, which would make co-operation easier, enabling them to appreciate requirements and how far they could be supplied. In closing the discussion, Mr. Glenn Marsden had a good word to say for the electrical contractor, with whom, he pointed out, there should also be a harmonious feeling on the part of the central station and the manufacturer.

Ohio Electric Light Association Conference.

The sixteenth annual convention of the Ohio Electric Light Association has been held at Cedar Point, Lake Erie, the session lasting three days, and there being 355 delegates. A good deal was said about popularising electricity. A notable paper in this respect was that by Mr. L. A. Pettit, Jun., of Middletown Lighting Company, who spoke on "Methods of Obtaining New Business in Cities of 15,000 or Less." Good organisation and wise advertising were necessary. "Display," he said, "such appliances as are within the reach of the pocket-book of the average customer, appliances that might be classed as necessities rather than luxuries. Arrange with manufacturers to furnish washing machines, vacuum cleaners, pumps, coffee mills, food choppers, forge blowers, and small machine tools on 30 or 60 days' consignment for demonstrating purposes. Have as large a display window as possible, and make it attractive. Place in it mechanical displays, demonstrators, etc. Change this display every week. Remember that one thing well displayed is better than to have the window filled with something which does not pertain to your business. Make it distinctive. Keep the people's attention fixed. Last, but decidedly of no less importance, is to have it properly illuminated."

Single-Phase Motors.

Professor F. C. Caldwell, of the Ohio State University, discoursed on "Motors for Single-Phase Circuits as they are To-day." Premising that there were at least six distinct types of motors which could be operated on single-phase currents, and might be termed shunt, series, simple induction, split-phase induction, simple repulsion, and repulsion-induction, he said that on account of the complication involved in the various types of single-phase motors, they are essentially more expensive than polyphase, but this is often more than offset by the decreased cost of circuits and transformers due to the two instead of three-wire distribution. The lower iron loss in the one transformer instead of two or three small ones is also to be considered.

Electric Motor Vehicles.

Speaking on "What Progress is Being Made in the Introduction of Electric Vehicles," Mr. J. T. Kermode, of the Cleveland Illuminating Company, said there were 1,796 electric vehicles registered in Ohio, of which 1,030 were in Cleveland. In that city there were 596 private and 14 public charging stations. Mr. Kermode said that the central stations must inaugurate a system of inspection of batteries and transmission gearing that will insure good operating results to the owners of electric cars. This does not necessarily mean the establishment and operation of garages by the central station, but does mean the employment by the central station of labour skilled in electrical and mechanical engineering pertaining to electric vehicles, in order to educate the public garage men in care and maintenance of batteries and transmission, and the owners of cars in care of charging and in the knowledge of results that should obtain from the services of necessity performed by the garage. He said a word in praise of mercury rectifiers, and was emphatic in the usefulness in every charging plant is a discharge rheostat for the purpose of completely discharging the batteries occasionally. This should be thoroughly explained to all owners of electric cars, so that they may realise the importance of treating their batteries properly.

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Tungsten Lamps.

Three very interesting papers on tungsten lamps were read. Mr. C. C. Custer, of the Miami Light, Heat and Power Company, and Mr. Claude Smith, of the Bradford and Gettysburg Electric Light and Power Company, both dealt with experience with series tungsten lamps for street lighting, and concluding in their favour. I will give full abstracts of this next week. Mr. E. L. Booth was concerned with "Tungsten Lamps *v.* Central Station Earnings." He thought that the use of a more efficient means of converting electricity into light should certainly also create an economic saving to the central station. The matter, however, was chiefly one of charging, though something might be done to mitigate less by securing new business, particularly off-peak load. Mr. M. D. Cooper, of the engineering department of the National Electric Lamp Association, agreed with Mr. Booth. The straight meter rate was slowly but surely being replaced by better methods. His department had been devoting considerable time to the rate situation in an effort to be of assistance to the central stations of the country with respect to the question of rate determination. While this investigation has been confined mainly to a study of steam plants in fairly large cities, the analyses have shown rather unfortunate results. Compilation of statistics by S. E. Doane, chief engineer of the association, shows that for an average station about 14·6% of the total annual cost depended upon the number of customers served; 55·1% upon the size of the plant or upon the maximum demand for power, and 30·3% upon the output in kilowatt-hours. A reasonable division of the charges seems to indicate a trinity which might be indicated as a demand charge, customer charge, and output charge. The customer charge will vary according to the demand. In some cases it might be well to make use of a flat meter rate. Flat rates based on guarantee demand need not be feared, for the class of customers with whom the difference between \$1.50 and \$2 for the monthly bill decides the question of electricity or no electricity, would undoubtedly use high-efficiency lamps to keep down the demand, and if they bought their renewals they would be careful about needless burning.

Central Station Economics.

Inite germane to the above papers was that by Mr. J. R. Cravath, who gave the results of his inquiries as regards central station facts and factors. Although far too many stations had neglected to answer his question, he had received enough data from which to draw conclusions. Liabilities per kilowatt should be kept as low as possible; gross yearly income per kilowatt should be pushed up, as should gross per \$100 liabilities; the ratio of operating service to gross receipts should be as low as is consistent with good service. As a general thing, stations with considerable connected motor and heating load stand a better chance for good earnings than those of the small motor and heating loads. The kilowatt-hours sold or accounted for should be high, and the transformer capacity should not be too much in excess of the average capacities found by these investigations. Small companies generally operate at a greater margin of profit than the larger companies. That they do not make a better showing is due to the difficulty of securing proper management.

Steam Turbine Troubles.

Mr. F. R. Brosius, of the Columbus Railway and Light Company, talked about certain minor troubles met with in running one 1,500 kw. and two 500 kw. steam turbines. All these were of the vertical-shaft type. Although trouble had arisen by reason of the failure to maintain pressure for the lubricant of the step bearing, the author expressed the opinion that the bearing as now arranged does not give as much trouble as does the average engine crank. He found that the top, middle and bottom bearings must be kept in perfect condition and alignment and closely fitted, or trouble will be met in the machine vibrating. Proper lubrication was also necessary. But this type of bearing must not be flooded with oil as are the bearings in the reciprocating engine. Trouble was experienced with these bearings throwing oil into the generator, which was overcome by fitting felt collars tight around the shaft above the middle bearings and below the top bearing. The expense for packing the pumps for maintaining the pressure in the lubricant is quite high. In three year's operation of the pumps for the 1,500 kw. unit, the plungers have been packed on an average of about six times per year, the rods have been packed about twice per year, and the valves have been re-ground about twice per year. When the 500 kw. turbines were installed, each one was provided with a triplex motor-driven pump for the lubricant of the step bearings. Later a reserve hydraulic steam pump was installed, being so arranged as to boost up the pressure on the step bearings immediately in case of trouble with the motor-driven pumps. Use is made of an automatic regulator set at a pressure of about 5 lb. lower than the pressure regularly carried on the step bearings. In case either motor-driven oil pump should drop the pressure, the steam pump at once comes into action. This system has operated satisfactorily since installation. A source of loss of economy with the vertical-type turbine, which might easily be neglected, is the carbon packing rings on the shaft for the purpose of sealing the turbine for vacuum. It is absolutely necessary that vacuum be maintained at a high point on the turbine outfit, if economy is to be expected in its operation. The carbon rings must be constantly watched and re-fitted to the shaft to overcome the possibility of any leaks at this point. The rings must be brought nearly to size and then scraped and spotted to the shaft, exercising a great deal more care in this work than is necessary with a bearing surface or with boxes. For this reason the water-lubricated step bearing seems preferable to the oil-lubricated bearing, as it does away with one set of carbon packing and there is no danger of air leaks from this bearing. This trouble is overcome in the latest types of horizontal turbines by mounting on the shaft a small centrifugal pump which throws a film of water around the shaft and seals the turbine for vacuum.

Electricity at Coney Island.

The Edison Electric Illuminating Company, of Brooklyn has received a notable accession to its day load and revenue by reason of the Steeplechase Park, Coney Island, giving up its 1,200 h.p. private plant, and going for its supply to the company. The Steeplechase Park people found it was not economical to run its isolated plant during the summer and close it down in winter. The Edison Illuminating Company now enjoy a practical monopoly at Coney Island, which is a splendid position, because it gives them a heavy summer load, when the city lighting load is at its lowest. The Steeplechase Park demand amounts to 800 kw.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

Question No. 1226.—Bare wires of galvanised iron are used for signalling in a colliery. It is found that when the wires come in contact with the stone at the side of the road that the bells will still ring, but the positive gradually rusts away and the negative has a white deposit by it, which tastes salty. The pit is very dry. The wires have a trembling bell and 10 cells (cells in series) connected across them at distances of about 100 yards apart. What is the cause of corrosion and what is the salt which forms?—A. L.

Question No. 1227.—What type of motor is best for metal shears? Compare A.C. and D.C. machines and state what horse power is required for a given duty and how the power is dissipated between the various resistances. How does the horse power vary during

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the cycle and how does the length of cycle affect matters? Is there any reliable relationship between the area of metal cut and the power required, and what flywheel capacity is required? Also how is the latter determined?—"CONSTANT."

ANSWER.

Question No. 1222.—Give curves and tables showing the variation in candle-power and resistance of carbon filament, and also, if possible, Osram and Tantalum filament lamps, with voltages varying from nought to normal. The examples may be either 110 or 220 volts, say, 16 candle-power.

Answer to Question No. 1222 (*awarded* 10*s.*).—Among the most recent and reliable researches concerning the effect of variations in terminal voltage on the resistance, current flow, wattage and candle power of incandescent glow lamps are those described by Jolley in the "Electrician"

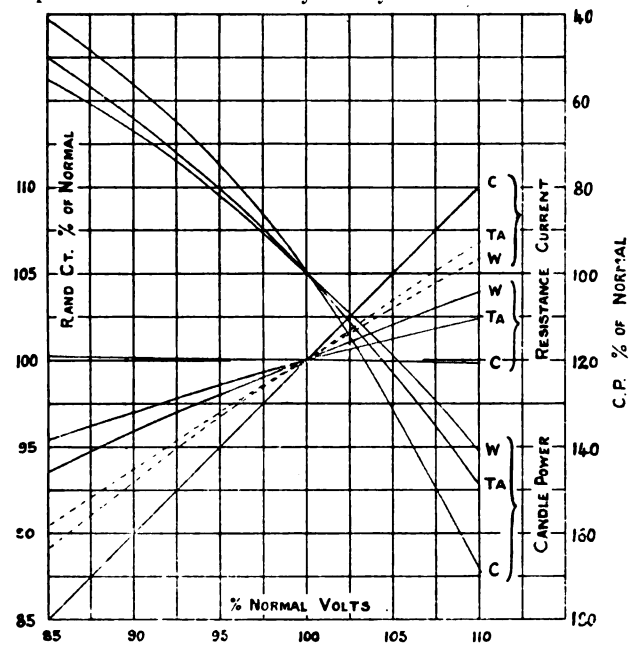

FIG. 1.

(August 13 and 20, 1909). Curves and data there given, appear to almost exactly cover "E.J.'s" requirements. Possibly, however, "E.J." had these results in mind when wording his query, and, in any case, they are so readily accessible that the present reply is better devoted to the subjoined data and curves. The curves of Figs. 1 and 2 fully cover all actual conditions of working, and, by confining attention to voltages lying between 85% and 110% normal, greater accuracy can be obtained from curves of given size than by attempting a range from 0—100% normal p.d.; the practical utility of the curves is thus enhanced. For similar curves, continued back to zero volts, reference should be made to Jolley's curves (*loc. cit.*) and to Solomon's "Electric Lamps" (Constable & Company).

It is often convenient to be able to calculate the probable candle power variation accompanying a change in applied voltage.

$$C.P. = a.V^n$$

where *C.P.* = candle-power of lamp when supplied at V volts.

a = a constant for each lamp, determined from a knowledge of its normal c.p. and voltage.

n = an index having the values shown in Table I.

TABLE I.

Filament Material.	Watts m.h.c.p.	Index. n
Carbon	4·0 ..	6·6
Metallised Carbon ..	3·1 ..	5·4
"Gem" Filaments ..	2·5 ..	4·0
Tantalum	2·0 ..	4·0
Osmium	1·5 ..	3·8
Tungsten (Osram, etc.) ..	1·25 ..	3·6

CADY.

The index n depends considerably upon the efficiency at which a lamp is run, hence the assumed ratings are quoted above: n decreases as the efficiency increases.

Metallic filaments are less affected by voltage fluctuations than are carbon filament lamps: this is due mainly to the positive temperature co-efficient of resistance of the former (carbon has a negative co-efficient—see Fig. 1). The effect of the different T—R co-efficients is very clearly shown by the subjoined data:—

CURRENT VARIATIONS WITH VOLTAGE CHANGE:—

Reduction of Current at 85% *normal volts.*

Carbon.	Tantalum.	Tungsten.
15%	11%	9%

Increase Current at 110% *normal volts.*

Carbon.	Tantalum.	Tungsten.
10%	9%	6%

Range of Current Variation (85%—110% *volts*).

Carbon.	Tantalum.	Tungsten.
25%	20%	15%

A given voltage variation thus produces considerably greater current variation in carbon than in metallic filament lamps. The wattage is necessarily affected in a similar manner (see Fig. 2). The more rapid variation of C.P. with voltage, in the case of carbon lamps has already been noted (see Fig 1 and Table 1). Combining the wattage and candle-power variation curves, the voltage-efficiency curves of Fig. 2 are obtained. These show that, once again, carbon lamps are considerably more sensitive to voltage variations than metallic filament lamps.

The efficiency of all types of glow lamps increases rapidly with rising voltage, but the life of the lamp is greatly curtailed: thus in the case of carbon filament lamps the life at various efficiencies and voltages may be as in Table 2. 100% consumption is taken to be 4 watts per c.p. and 100% life = 1,500 hours; the great effect of a relatively small voltage rise is very noticeable. Metallic filament lamps are less affected under similar conditions.

TABLE II.

Voltage Normal		Watts c.p. 4 = 100%	3 = 75%	2 = 50%
		Life hrs. 1500 = 100%	600 = 40%	150 = 10%
+ 2% volts.	Consumption	93%	70%	47½%
	Life	73½%	30%	8%
+ 5% volts.	Consumption	80%	65%	42½%
	Life	50%	22%	5·7%
+ 7% volts.	Consumption	75%	60%	—
	Life	40%	16·7%	—

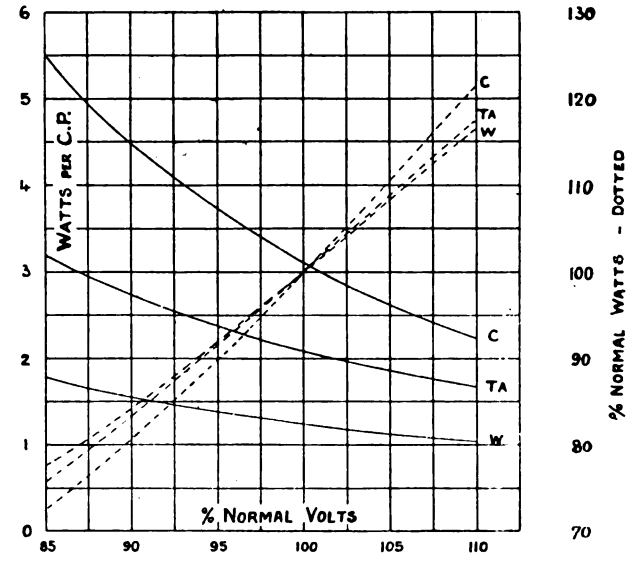

FIG. 2.

To secure maximum life from glow lamps it is necessary that voltage variations (at least up to =5% normal, such as are inevitable on all commercial circuits) should produce as small as possible variation from normal conditions and effects. On this account alone metallic filaments would have a proportionately longer life than carbon filaments. —W. M.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ALDERSHOT.—The Urban District's electricity department receipts during the past year was £4,559, and the expenditure £2,580; after providing for interest and re-payments, there was a net balance of £335. Mr. F. Garside, the engineer, is able to report a fair increase in the demand for energy, the additional revenue from private consumers being £480.

DUBLIN.—Great improvement is expected to result from the new boiler equipment put up by Messrs. Babcock & Wilcox. It includes: (1) the erection of a new water-tube boiler, superheater, and mechanical stoker, with all necessary connections, etc., and (2) moving the Yarrow boiler—some time since the subject of much controversy—to a new position, and fitting it with a mechanical stoker and the necessary driving gear. Certain other incidental work was included in the contract, such as the roofing in of the space occupied by the Yarrow boiler in its new position, the building of a new self-supporting steel chimney stack, moving section of the draft plant to a position near the steel chimney stack and connecting thereto, and carrying out all necessary brick and steel work and other details, the total amount of the contract being £6,447. The official tests of the efficiency of the plant are favourably reported on by the city electrical engineer.

FRODINGHAM AND BRUMBY.—The Urban District Council have decided to apply to the Local Government Board for powers to raise £1,000 for the purpose of lighting the streets by electricity.

HASLINGDEN.—Terms have been agreed to under which Accrington will from August of next year supply Haslingden with electricity in bulk. Accrington are seeking the Board of Trade's approval to the scheme, and Haslingden will apply for powers to borrow money to enable them to supply consumers in their borough.

IPSWICH.—The Corporation free wiring and installation departments of the electricity undertaking have proved decided successes here. During the two years of the free wiring (rental) systems 51 new consumers out of a total of 128 have been secured by it, while last year the installation department on a turnover of £3,043 made a profit of £166. The total revenue of the electricity undertaking for the year ending March 31 was £14,158, of which £6,801 was obtained from private lighting, £2,111 from power, £4,737 from traction, and only £44 from public lighting. The expenditure was £10,162. After providing for interest, re-payments on debt, and paying certain improvements out of revenue, a balance of £735 was transferred to reserve account.

LLANDAFF AND DINAS POWIS.—The Rural District Council are calling for tenders for the erection of an electric lighting substation at Heoldon, in the parish of Whitchurch.

MAIDSTONE.—The Corporation are putting in an economiser at their electricity works, at a cost of £343 10s., which is to be paid out of revenue, spread over a period of five years. It is expected that a saving of 10% on the fuel consumption, or about £400 per annum, will be effected. The contractors are Messrs. Lowcock, Ltd.

MORECAMBE.—Mr. W. R. Wright has terminated his engagement as consulting engineer to the electricity works on receipt of £155 in settlement of his claims against the corporation.

SKIPTON.—It has been decided to instal an electric lighting plant at the Town Hall in order to permit of cinematograph demonstrations being given there.

SOUTHEND-ON-SEA.—Extensions of the mains are to be undertaken in Wenham-drive and Silverdale-avenue at a cost of a little over £40.

WEST HAM.—The Local Government Board have sanctioned the application of the Borough to borrow the sums of £67,025 and £51,500 for electricity extension purposes. Application for the first sum (originally £74,000, but reduced) was made last year, and for the second in May of this year, the public inquiry being held in July. This is prompt work for Whitehall, and is no doubt due to a desire to assist the Corporation out of its difficulties.

YSTRADGYNLAIS.—The Rural District Council are inviting applications from qualified electrical engineers for carrying out the duties of supervising the erection of an electric light installation in the village. The appointment is to commence on September 1st and to last for six months.

OVERSEAS.

LA PLATA.—A company has been formed in Buenos Aires to take up the concession granted to Mr. A. Lemousin for an electric light and power house here. This new company will be in direct competition with the River Plate Electricity Company, which has worked in La Plata for many years.

MONTEVIDEO.—The Uruguayan Government has approved the proposed reduction in the price of current supplied to industrial establishments in Montevideo. The new rate is to be two cents gold per kw. hour when the total consumption of any consumer exceeds 2,000 kw. hours per month.

PRETORIA.—A Government inquiry has been held at Pretoria with regard to a proposal by the municipality to adopt an electric lighting scheme at a cost of £20,000.

WELLINGTON, NEW ZEALAND.—Mr. G. H. F. Rolleston, H.M. Trade Commissioner, 9, Grey-street, announces that a local firm desires to get into touch with British manufacturers of porcelain insulators, and that he is prepared to receive catalogues and particulars.

TRACTION.

HOME.

IPSWICH.—In spite of a small increase of £714 in revenue, the Corporation tramways made a loss of £1,731 on the trading for the year ending March 31. The total revenue was £20,882 (£20,106 from passenger traffic and £197 from passengers' luggage), while the expenditure was £16,589, the adverse balance being made up of interest and re-payments.

LEEDS.—An agreement between the Corporation and the town of Morley provides for the Leeds city tramways to be carried through Morley to a point about a mile on the other side of that town. This extension from Charwell station will mean an addition of a little over three miles.

ORMSKIRK.—The Lancashire and Yorkshire Railway, satisfied with the electrification of the line from Aintree to Maghull, is about to extend the system as far as this. Already sanction for this has been obtained from the West Lancashire Rural District Council.

OVERSEAS.

GEELONG, VICTORIA.—An Order-in-Council authorising the Melbourne Electric Supply Company to construct electric tramways in Geelong has been passed. The lease is for 30 years, to be extended by five yearly periods, at the option of the municipalities.

KECSKEMET, HUNGARY.—The municipal authorities have arranged to contract a loan of 1,500,000 kronen (£62,500) for the purpose of constructing an electric tramway.

VANCOUVER.—Preparations are being made to extend the British Columbia Electric Railway to the Saanich peninsula.

COMPANIES' MEETINGS AND REPORTS.

NORTH METROPOLITAN TRAMWAYS COMPANY.

The 81st half-yearly meeting was held at Electrical Federation Offices, Kingsway, Mr. James Devonshire presiding, in the absence of Mr. George Richardson. In moving the adoption of the report, he stated that the net profit for the half-year was £384, which with the sum of £80 brought forward would be carried forward to the current half-year's accounts. At the meeting last February Mr. Richardson said he thought that with the anticipated boom in trade they would have an opportunity of disposing of the remaining assets of any consequence that were still possessed by the company. They had not, however, been successful in that; in fact, they had not had any inquiries during the half-year under review. The directors were therefore considering whether, in the circumstances, they should not try to realise the assets for what they would fetch at public auction, and thus enable the company to go into liquidation. Should they decide on that course, the proprietors would have every facility for attending the auction and bidding for properties if they desired to do so. There was roughly about £1,000 still to distribute out of the proceeds of what they had already sold, but the directors could not make any distribution without going to the Court for an order. That would entail considerable time and expense, but once the company went into liquidation the liquidator could make distributions as and when he pleased without reference to the Court. They had settled nothing yet, but they were giving the matter serious consideration. Mr. J. W. Greig seconded the motion, which was adopted.

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NAIROBI ELECTRIC POWER AND LIGHTING

The directors report that the accounts for the period up to December 31, 1908, included only the first few months of revenue earning period, and of necessity, the working expenses at Nairobi were considerably in excess of the receipts, making a net working loss of £1,233 11s. 11d. The steady progress of the company's operations during 1909 has resulted in the receipts being slightly in excess of all the working expenses there. There has been considerable further expenditure on capital account, and this is still proceeding. During the present year further good progress has been made, as will be seen by the following figures :—

	AT 31/12/08	AT 31/12/09	AT 30/6/10
Number of Customers connected	—	178	228
Motors connected, B.H.P.	31	64	89
Lights connected, 8 c.p. equivalents	2479	3628	4728
Street Lighting, 8 c.p. equivalents	nil.	nil.	1192

Numerous additional orders are in hand or being negotiated, and the directors anticipate that by the end of the present year the receipts will be more than sufficient to meet all working expenses at Nairobi and London, and debenture interest. The company's operations at Nairobi have continued under the same supervision and management, with Mr. R. C. Bayldon as managing director, and Mr. Chas. Udall as chief engineer, and the prospects for the immediate future appear to be very satisfactory. The company's Nairobi accounts have been audited on the spot by Mr. Ernest B. Gill, chartered accountant, with whom arrangements have been made for a monthly audit of the cash account, so that the directors and shareholders may be assured that the African accounts are in a satisfactory condition.

PERSONAL.

Mr. W. E. Wright, on the occasion of his marriage, was presented by his colleagues on the staff of the York Corporation Electricity and Tramways Department with a handsome case of plate.

Mr. William Dummer, of College-square, Llanelly, has been appointed mechanical and electrical engineer on the staff of the G.P.O., Manchester District. Mr. Dummer has been appointed from the electrical department of the Manchester Corporation.

Mr. W. H. Chatten, electrical fitter apprentice, of Sheerness Dockyard, who was recently awarded the first Admiralty scholarship in electrical engineering, tenable at the Royal Naval College, Greenwich, has been awarded by the Board of Education a Whitworth Exhibition of £50 as a result of the science and art examinations held in May last.

The Governors of Faraday-house have appointed Mr. E. A. Nash, A.C.I.S., A.I.E.E., as Secretary and Business Manager of the Electrical Standardising Testing and Training Institution, in the place of Mr. Howard Foulds, who was recently appointed Secretary of the Electricity Department, Birmingham.

Messrs. Elles, Hill, Boothroyd & Company, 79, Mark-lane, E.C., have been appointed auditors by the Kent County Council to audit the accounts of the Kent Electric Power Company, Ltd., under powers given to them by the Chatham, Rochester and District Lighting Order of 1890.

Mr. Speakman, of Deptford, has been elected president of the Amalgamated Association of Tramway and Vehicle Workers.

Mr. F. K. Cassels, M.I.E.E., accompanied by his family, is leaving Buenos Aires to take up his residence in New Zealand.

Mr. R. P. Russell has left England to take up an appointment as assistant engineer (electric light) at Kuala Lampur, Malay States.

Mr. A. Murray Coombs, A.M.I.E.E., consulting engineer, of 31, Charing-cross, S.W., has been appointed inspector for supplies in England for the South Indian and G.I.P. Railways.

FINANCIAL NOTES.

NORTHAMPTON ELECTRIC LIGHT AND POWER.—The directors have decided to pay a half-year's dividend at the rate of 5% per annum on the Preference shares, and an interim dividend at the same rate on the ordinary shares, for the half-year ended June 30. The interim dividend paid on the Ordinary shares for the corresponding period of 1909 was at the rate of 4½% per annum.

* * *

MEXICAN LIGHT AND POWER.—The annual general meeting was held at Toronto. The chairman stated that the storage capacity had increased. Twenty million cubic metres of water were now on hand. The net revenue for the year was $2,426,811. After paying management fixed charges and dividends of 7% on Preference shares and 4% on Common stock, $149,385 was carried forward.

* * *

LLANELLY AND DISTRICT ELECTRIC LIGHTING.—The authorised share capital of the Llanelly and District Electric Lighting and Traction Company, Ltd., is £120,000, divided into 60,000 6% Cumulative Preference shares of £1 each, 45,000 Ordinary shares of £1 each, and 15,000 Deferred Ordinary shares of £1 each. Of the above, 12,915 Deferred Ordinary shares have been issued at date and are fully paid. The company has power to raise money by the issue of debentures or debenture stock, but the amount so raised shall not exceed the nominal amount of the Preference share capital, without the sanction of the holders of the Preference shares. A fresh issue has now been made of 60,000 6% Cumulative Preference shares of £1 each at par.

EDUCATIONAL.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.

L.C.C. AND FREE PLACES.

As already announced, on December 21, 1909, the London County Council decided to make a maintenance grant of £8,000 to the Imperial College of Science and Technology, South Kensington. In return for this grant it secures the privilege of nominating 25 students for one year's free instruction at the Imperial College. These are now to be filled for the first time. The instruction will be of an advanced nature and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident in the Administrative County of London, and must be students at an institution aided, maintained or approved by the Council. The free studentships do not entitle the holders to any maintenance grants, but cover all ordinary tuition fees. No examination will be adopted for the final selection of the students from the applications received. The free studentships will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow and generally upon their fitness for advanced study in Science applied to industry. It is quite possible that, in special cases, the free places may be extended to two or more years. Owing to the summer recess it has been decided to accept entries for the free places until Saturday, October 1, 1910. Application forms (T.2/268) can be obtained from the Education Officer, London County Council, Victoria-embankment, London, W.C.

UNIVERSITY COLLEGE, LONDON.

Particulars will be found in another column of the Faculty of Engineering, 1910–11 Session, commencing on Monday, October 3. Intending students must communicate with the Provost not later than September 20, giving full particulars of their previous training.

BRAZILIAN GOLDFIELDS.—At the eighth general meeting of the Brazilian Goldfields, Ltd., one of the shareholders Mr. Hett, said that all that was necessary to make a success of their property was to secure sufficient capital to lay down turbines and generate sufficient electrical power to drive the machinery of all the associated mines.

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PATENTS.

Electrodes of Secondary Batteries.

9066.—1909. H. Garde & A. J. Adams, London, W.C. The object is to provide thinner electrodes of larger surface and greater porosity than have hitherto been in use, and which will not grow, bend, buckle or otherwise lose their shape. The grids have no outside borders of greater thickness or strength than the inside members, so that the resistance presented to expansion by the surrounding portions of the electrodes is no greater than that presented by the central parts. The grids are pasted with lead oxide, and after being allowed to set and dry they are reduced to a spongy lead state by being formed negative. They are then placed between felt sheets and pressed so as to consolidate the active material. After this the electrodes are formed positive at a medium current and discharged. The process is repeated at an increasing current, which will cause the electrodes to grow until the active material is fully converted into lead peroxide, after which no more growth will occur. The electrodes are again formed negative and pressed. Having retained the size to which they grew the electrodes will be thinner and have more porosity than when first formed negative and positive.

Charging and Discharging Secondary Batteries.

14212.—1909. A. M. Taylor, Kings Heath. In order to reduce the capital cost of batteries and battery boosters and to increase the efficiency of the latter in sub-stations distributing with direct current but fed with either alternating or direct current, a simple booster of double the E.M.F. is employed in the three wire system instead of having two or more separate boosters. The improved booster has two tappings on its armature winding connected with slip rings carried by the armature, and is connected to a static balancer of special construction designed to compensate automatically for fluctuations in the out of balance load. In the case of two booster armatures being arranged for series parallel grouping the potential of the neutral bus-bar of the three wire system is given by means of static balancers connected up in such a way that when the main change over switches are operated which put the booster armatures in parallel the static balancers can be connected at the same time by similar change over switches which rearrange the connections of the static balancer in such a way as to avoid short circuiting any part of the system when the boosters are in series.

Electric Speed Indicator.

16621.—1909. J. Rennie, Putney. This instrument, which is designed to indicate the speed of a vehicle, comprises a compound bar heated by the current to be measured and arranged to move a pointer over a scale and a second compound bar which moves the scale. An adiathermanous screen is provided between the bars in order to prevent the heat of the one bar from affecting the movement of the other.

Electric Distribution Systems.

16645.—1909. Dalziel's Constant Voltage Patents, Ltd., & J. Dalziel, Derby. The object is to provide a method and apparatus for regulating the voltage of the current supplied from generators in which the pressure is likely to fluctuate. The apparatus has a booster mounted on a shaft and made to give the additional voltage necessary for charging the battery. The booster has an inverse series winding made to reduce the charging voltage, but not the main voltage if the current increases beyond a certain predetermined amount. A switch gear prevents the booster from being connected to the prime mover by which it is driven until the speed of the prime mover is above that at which the speed of the apparatus is cut into action.

Electric Sleeve Ironer.

16737.—1909. E. Jansen, Paderborn. The body of the iron is hollow and has a domed surface. An electric heater is fitted in the iron which is mounted on an upright handle. Electric leads are carried from the heater through the handle and connected to two projecting plates at the end of the handle. The device is mounted between two contact pieces which serve to hold the device in position and to pass an electric current through the heater.

Protective Devices for Electrical Transmission and Distributing Systems.

17031.—1909. British Thomson-Houston Company, Ltd., London, E.C. Each conductor of a circuit has a transformer. These are connected in parallel and provided with a return circuit with tripping devices arranged in series with an individual transformer which serves for overload protection. As soon as any leakage takes place a resultant current flows in the return circuit.

Small Electric Transformers.

17043.—1909. Deutsche Elektro Sparlicht, G.m.b.H., Frankfort a Main. According to this invention, where it is necessary to provide bolts to pass through the casing for purposes of suspension, the bolt holes are arranged at the point of the smallest magnetic flux.

Electric Traction Systems.

18499.—1909. E. G. Pink, Dover. The road is divided into tracks consisting of steel plateways fixed to lines of I section steel girders resting on a concrete bed. The spaces between the plateways are filled with concrete and finished off with a suitable paving. The space beneath the plateway is utilised for drawing in and storing cables. The girders and tracks are electrically bonded. The overhead conductors which are fixed over the centre of the track consist of rolled steel of channel section fixed to light girders spanning the road and resting on columns. The metal tyres of the vehicles are electrically connected with the motor. Vehicles of different grades are confined as far as possible to their different tracks and fitted with motors geared to a given maximum speed.

Illuminated Signs.

19623.—1909. Hamburger Elektricitats, G.m.b.H., Altona. The sign is illumined from a source of light situated at its optical centre. The letters or designs are directly formed on a curved surface by means of a substance such as rough gold leaf, which dispenses and reflects the light, so that the rays coming from the source of light are only reflected by the places which have been coated, thereby giving the appearance of a self-luminous sign.

Electric Joints.

20106.—1909. C. J. Beaver & E. A. Claremont, Hale. The apparatus consists of a connector with a shell attached to one end, and is of such shape and size as to be capable of encircling and enclosing all those parts of the joint which comprise junctions between dissimilar metals, and which holds a bed of non-conducting material around such parts for the purpose of preventing exposure of such junctions to the atmosphere. Apertures are provided for the introduction of the non-conducting material.

Shade Holders for Incandescent Electric Lights.

20666.—1909. C. Arnold, Westcliff-on-Sea. The holder comprises a ring provided with clips which converge inwardly and upwardly to a smaller diameter than the ring and then extend outwardly. The action of slipping the holder over the barrel of the lamp-holder forces the spring outwards, whilst the tendency of the springs to remain in their normal position causes them to press against the barrel and fix the shade holder in position.

Electric Fire Alarm Apparatus.

22378.—1909. H. Knight, Ealing. In electric fire alarm circuits where alarm posts are joined up two or more in one circuit, a revolving disc is employed which engages with contact fingers none of which are directly connected with earth. When one alarm post has been operated all other alarm posts further away from the central station are disconnected so as to provide that the signal from one post only shall be received at the moment.

Telegraph Transmission and Receiving Apparatus.

23328.—1909. Electric Press Bulletin Company, Williamsport, U.S.A. This apparatus, which is designed to simultaneously actuate a number of bulletin printers, comprises a series of controller contacts at the receiving station and an electrically operated contact member which co-operates with the contacts. The contact member normally rotates freely between the contacts. The movement of the contact member against one of the contacts to cause operation is effected by a longitudinal movement of the axle which supports it.

Driving and Operating Electric Frequency Transformers having Commutators.

24269.—1909. Siemens Schuckertwerke, G.m.b.H., Berlin This arrangement for driving a polyphase frequency transformer by means of an asynchronous rotary field induction motor, is provided with means for varying the voltage ratio between the primary and secondary mains of the frequency transformer and connecting electrically the commutator brushes of the transformer to the slip rings of the motor and the slip rings of the transformer to the stator winding of the motor, or alternately the commutator brushes of the transformer to the stator winding of the motor and the slip rings of the transformer to the slip rings of the motor.

Magneto Electric Machines for Velocipede Lamps.

5043.—1910. C. Schilk, Coburg. The machine is hinged to a holder which has means for attachment to a velocipede and is connected to the holder by a spring so that the latter exerts a pull on the machine in each of two alternative positions into which the machine can be rocked in order to put it into or out of operation.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.				Receipts per			Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Passenger.	Car mile.	Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Aug. 17	1,679	1,758	— 79	— 354	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Aug. 14	1,215	1,183	+ 32	+ 457	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	Aug. 13	6,198	5,967	+ 231	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams.	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Aug. 13	5,401	5,425	— 24	+ 3,121	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Aug. 21	1,343	1,281	+ 62	— 60	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Aug. 19	6,352	5,986	+ 366	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Aug. 20	1,331	1,308	+ 23	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Aug. 21	278	280	— 2	— 58	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Aug. 13	4,716	4,302	+ 414	+ 1,960	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27*a*
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Aug. 21	2,971	3,062	— 91	+ 7	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Aug. 18	540	549	— 9	+ 1,605	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Aug. 5	2,216	2,051	+ 165	+ 3,368	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Aug. 19	184	167	+ 17	+ 45	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Aug. 19	6,109	6,199	— 90	— 61	54¼	54¼	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Aug. 20	1,103	1,022	+ 81	+ 446	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Aug. 13	18,118	17,431	+ 687	+ 10,962	195½	189	May 31	907,494	226,048,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,029	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Aug. 20	2,753	2,650	+ 103	+ 3,123	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Aug. 17	137	151	— 14	— 156	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Aug. 17	1,504	1,547	— 43	— 540	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Aug. 14	1,573	1,547	+ 26	+ 63	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Aug. 3	45,956	38,387	+ 7,569	+ 105969	136	119½	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	5·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Aug. 20	9,053	8,525	+ 528	+ 4,685	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Aug. 14	15,580	14,757	+ 823	+ 3,459	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Aug. 13	3,837	3,814	+ 23	+ 845	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·38
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Aug. 14	5,836	5,418	+ 418	+ 6,966	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Aug. 10	1,248	1,325	— 77	+ 506	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 13	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Aug. 13	1,098	1,093	+ 5	— 112	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 11	2,443	2,449	— 6	+ 1,901	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *h* Half-years' figures.

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THE
Electrical Engineer.
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WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Iron and Steel Institute Meeting.

The Iron and Steel Institute holds its annual meeting at Buxton from September 26 to 30 inclusive. The headquarters will be at the Town Hall. An excellent programme, includes the reading of 11 papers. Those possessing particular interest for our readers are: "On Electric Steel Refining," by Mr. D. F. Campbell, of London; "On the Utilisation of Electric Power in the Iron and Steel Industry," by Herr J. Elink Schuurman, of Baden, Switzerland; "On Some Experiments on Fatigue of Metals," by Mr. J. H. Smith, of Belfast; and "On the Preparation of Magnetic Oxides of Iron from Aqueous Solutions," by Herr S. Hilpert, of Charlottenburg.

Marconi Press Agency.

Few things could better bring to the attention of the general public the practical value of wireless telegraphy than the establishment of the Marconi Press Agency. The functions of this new organisation is to gather news of all happenings on the ocean, and to transmit these messages to the newspaper press. Thus the oceans of our little world will soon be as open to the scrutiny of the "Argus eyed" as dry land. This should serve a very useful purpose, besides bringing the availability of radiotelegraphy constantly and prominently before everybody. The new move will be welcomed, especially if the Marconi Agency does its duty strictly as a news gatherer. If it does this, the public will soon ask that its services shall be extended to the gathering of information on land. Serious students of politics and sociology have long been painfully aware of the urgent need for some new unbiased organisation, which would not only gather, but despatch from this busy "hub of the universe" items of news. At present both inward and outward telegraphic messages are tortured into representing one school of thought. There is a great opening for the Marconi move if it would branch out widely, and stick to undiluted facts.

Light Railways.

In June last the Board of Trade issued a report on the Light Railway Commissioners' work up to December 31 of last year. It appears that since the coming into operation of the Act of 1896, 599 applications for Orders to authorise light railways had been made, of which 98 applications were for amending Orders. Of these the Commissioners approved of four, referred 379 to the Board of Trade, deferred eight, and had under consideration nine; 199 were rejected or withdrawn. The printed returns, however, gave no indication of the actual state of affairs, but on application to the Board, Mr. Alan D. Erskine has supplied the Tramways and Light Railways' Association with a detailed list of 95 schemes, which, so far as the Board can ascertain, have been or are being carried out. There are 41 railways working, or in the course of construction, on land specially acquired for the purpose; of these, 210 miles are in England, 103¼ miles in Scotland, and 61 miles in Wales. Seven of these, measuring 67½ miles, are Parliamentary railways working under the Light Railways Act. Quite a number are, of course, worked by the big railway companies. Only one, the Gosforth to Ponteland, a little over seven miles long, and worked by the North-Eastern Railway, is an electric line. All the others are steam. Two—the Barton and Immingham, 12½ miles long, and the Lampeter, Aberoyen and New Quay, 22 miles long—are now under construction.

Electric Lines.

On the other hand, the 52 light railways constructed on public roads are worked by electricity. They are all, but three, in England, and the total length is 326½ miles. The longest is the Middlesex County Council line, worked by the Metropolitan Electric Tramways, 40¼ miles. That company also works the Hertford County Council line of a little over a mile-and-a-half. The three Welsh lines are the Glamorgan (County Council) Morriston Railway, half-a-mile long (the shortest of all); the Merthyr Tydfil, and the Swansea Corporation line, which is worked by the Swansea Improvements and Tramways Company.

Turin Telegraphing Competition.

We have received from the Italian Ministry of Posts and Telegraphs a copy of the regulations relating to the International Professional Telegraphists' Competition which is to take place at Turin on August 22, 1911, in connection with the International Exhibition of Work and Industries. The instruments to be used are the Morse, Hughes and Baudot. A competition in the use of automatic writing machines will take place only if not less than 10 competitors from three different countries enter for this class of work. There will be three classes of awards: Individual prizes for competitors in the Morse, Hughes and Baudot trials; these will consist of gold and silver medals and objects of art, and will become the property of the winners; the championship, a cup, which will be competed for among those who have gained prizes in each of the three sections; National Representation Prize, a cup, which will be competed for by representative winners of each nationality; this cup is to be kept at the headquarters of the Administration of the winner. Entries have to be sent in to the Ministry of Posts and Telegraphs (Secretariat-General, Bureau du Concours International de Telegraphie), Rome, not later than June 15, 1911.

Electric Light Stations and Insurance.

Searchlight has some rather scathing remarks upon certain recent proceedings at the West Ham Town Council. The Finance Committee recommended that all officials and workmen should be re-insured by an insurance company at an all-round rate of 6s. per individual, the amount to be debited to each department according to the number of employees and the special risks. Thereupon there were two amendments: one that the Tramways Department should take over their own risk, and the second, that the Corporation should do its own insurance. Ultimately the whole question was referred back for the purpose of considering the rates, and to make inquiries as regards tariff and non-tariff companies. Delay in these matters is certainly unwise. The risk of a corporation taking its own insurance is very great, and could scarcely lead to economy in the long run, except, perhaps, in a city employing a small army of men.

Chinese Enterprise.

We have on more than one occasion drawn attention to matters electrical in China, because it is a market that is worth cultivating and should be carefully watched. One form of enterprise is pointed out by Consul-General Fraser, who reports on the Yangtse Engineering Works, Ltd., of Hankow. It was registered at the Board of Commerce, Pekin, three years ago, was promoted by Dr. V. K. Lee, managing director of the Hanyang Works, and is officered by Chinese, the resident general manager being Mr. Wong

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Kong, M.I.N.A., M.I.Mech.E., M.I.San.Inst., a British subject from Hong Kong. It is largely equipped with electrical labour-saving appliances, which were supplied from England. Its chief work is concerned with railways, bridge building, and ship-building. No doubt the fact that the general manager is a British subject, and received his technical training over here, accounts for the preference shown throughout for British machinery. The point is, that what has been done at Hankow can be, and is likely soon to be done elsewhere, and it is well that a look out should be kept for any enterprises of this description.

Sport by Electric Light.

Electric light already lends its aid to the promotion of certain forms of sport—for instance, swimming in public baths, roller skating and skating on artificial ice. The question is whether it might not be still further utilised in this direction. A correspondent of the "Liverpool Daily Post," regretting that the shortening days proclaim the closing in of another bowling season, asks why Canadian lovers of the game should not be imitated over here? In Canada it is the custom to light the bowling greens by electricity, and thus the game is kept up throughout the year, and often up to 10 o'clock at night. The same course, it may be observed, is adopted in connection with curling. Here is a hint for local electrical wiring contractors and managers of central stations, who might do worse than interview proprietors of bowling greens, even canvassing tennis clubs, and so on.

Medical Electricity.

Dr. Carey Coombs has been recording his reminiscences of medical practice half a century ago. He has seen many changes, and notably so in connection with electricity. "Fifty years ago the use of the galvanic current was almost unknown," he says, "and even now few men realise its value enough to use the current from the public supply or their own portable batteries. . . . . High-tension electricity has come into use, and there are the Röntgen rays, and incandescent lamps have revealed much that is interesting in the nasal fossæ, the stomach, and bladder. . . . . Heat in the form of the actual cautery was being used less and less, but revived in the gas cautery, then in the Paquelin thermo-cautery (for which the instrument used in 'poker work' is a good substitute), and, best of all, in galvanocautery. The regular use of the air bath and of the hot chamber for single rheumatic joints, heated by the use of electricity, and the wonderful irradiation methods by the Finsen lamp and radium have all been established as valuable remedies in this period."

Diffused and Intensified Light.

Apropos of our first note last week, we would call attention to a letter of Mr. Frank Broadbent, 4, Queen-street-place, who, referring to the effect of electric light on eyesight, says: "A great mistake which night workers make is to keep the room in darkness, but to have a strong illumination on their work. The eye resents such strong contrasts. The room should be moderately lighted, say, with an illumination of about half a candle-foot, and the working portion (say, the table or desk) should have an illumination of 1½ to 2 candle-feet."

Potential Globe Trotters.

Keighley's Tramways Committee, as becomes the representatives of a go-ahead Northern borough, are anxious to be up-to-date, and with that view they asked the Council to sanction official visits to places where the trackless trolley system is in working order. Many of our populous north country boroughs clearly see that the system offers special advantages, only the Keighley fathers want to see it at work before they plump for the innovation. But members of the Council who do not sit on the Tramways Committee drew alarming pictures of the visiting members careering over not merely to Belgium, but to Austria, and perhaps even scampering all over America in search of trackless trolleys. The Chairman of the Committee disdained to offer any programme, he did not solemnly swear that the seekers after knowledge would not go off to Vienna, over even to America; see the system at work they must, and he got his way. It will be interesting to see where they really do go. But out of this little episode the practical question crops up whether some effective system could not be devised for exchange of experience between boroughs and experts. Many of our tramway engineers are quite familiar with trackless trolley systems; so, too, are many members of Tramway Committees, for instance, not further away than Bradford.

Hydro-Electrics in New Zealand.

A very firm stand has been taken by the Government of the Dominion of New Zealand as regards the utilisation of natural water power. The Government is promoting legislation whereby it will reserve to itself the exploitation of water power and hydro-electric schemes, rather than let these get into the hands of private companies or even of corporations. Interviewed on the question, Sir Joseph Ward, the Prime Minister, explained that it was found that people were endeavouring to snatch very large profits indeed for the sale of options without doing a stroke of work. Of course, that means that the actual consumer would ultimately have to pay the piper. But it is essential for the welfare of a community that light and power should be available as cheaply as posible. Finally, Sir Joseph said the Government fully recognised that the matter should receive attention at an early date, and had also come to the conclusion that it was in the best interests of the State that the Government should control the whole of these powers from end to end of New Zealand.

The Engineering and Machinery Exhibition.

Yesterday the Naval, Mercantile Marine and General Engineering and Machinery Exhibition opened at Olympia. It makes a brave show, of which we hope to say more later on. At Manchester the Engineering and Machinery Exhibition opens on October 14 to remain open until November 5. There is every prospect of this turning out a big success, and we refer our readers to another page in this issue, in which full particulars of the venture are given.

Electric Lighting Further Powers Bill.

We have received from the Honorary Secretary of the Incorporated Municipal Electrical Association an interesting list and notes of towns which have replied to the Association's circular letter asking for support for the proposed Bill to seek further powers under the Electric Lighting Act, 1909. So far, 72 towns have replied, and not a single one altogether unfavourably. The following have promised financial support:—Barnes, Barrow, Bolton, Blackpool, Bradford, Cardiff, Coventry, Croydon, Devonport, Dewsbury, Eastbourne, Eccles, Govan, Gillingham, Hastings, Ilkeston, Ilford, Londonderry, Lincoln, Maidstone, Middlesbrough, Peterborough, Portsmouth, Rochdale, Sheffield, St. Marylebone, St. Helens, Taunton, Walsall, West Ham, Wimbledon, Wigan, Edinburgh, Glasgow, Doncaster, Bristol. Those who will give moral support are:—Birkenhead, Bury, Broughty Ferry, Colne, Canterbury, Dartford, Exeter, Fulham, Falkirk, Hackney, Loughborough, Southend-on-Sea, Shipley, West Bromwich, Warrington, Halifax. Five are non-committal, merely declaring themselves in favour of proposal. These are:—Brighton, Carlisle, Darlington, Keighley, Swindon. The next twelve will take no action:—Aberdeen, Epsom, Farnworth, Grimsby, Hammersmith, Ipswich, Liverpool, Salford, Southwark, Tunbridge Wells, Batley, Sutton Coldfield, while Derby will consider the matter again; Hull says Yes, as regards standby by unauthorised undertakers but not wiring; and Mansfield already possesses powers. Many other boroughs, including the Metropolitan boroughs, are in the same happy position, and, bearing this in mind, it is evident that the movement enjoys strong approval.

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TUNGSTEN LAMPS FOR STREET LIGHTING.

By Our New York Correspondent.

As announced in my last letter, a great deal of attention was devoted to the economics of tungsten lamps at the Ohio Electric Association's Convention. Apart from Mr. F. L. Booth's paper, which was concerned with the saving of current effected by tungsten lamps and its influence on central station results, most interest was manifested in the topic of street lighting by series tungsten lamps. This subject was discussed by Mr. C. C. Custer, of the Miami Light, Heat and Power Company, and by Mr. Claude Smith, of the Bradford and Gettysburg Electric Light and Power Company. Both spoke from actual experience on a large scale and over fairly long periods.

Mr. Smith went into details pretty fully. He explained that his company went in for series tungsten lamps for street lighting in November, 1908, when they installed a series street-lighting system using the 75-watt, 60 c.p. tungsten lamp, which was the largest unit then available. The specifications of the local committee on street lighting called for mast arms not less than 16 ft. long, the lamps to be 16·5 ft. above the roadways. These mast arms were built by the local linemen, and were of 1·25 in. iron pipe trussed with the $\frac{3}{8}$ in. iron rods, which were spread about 18 in. apart near the centre of the area by a V-shaped spreader iron. The arms cost complete, installed on poles, about $4 each. Four men with a horse and wagon erected on an average of 20 arms per day. On the last installations the $\frac{3}{8}$ truss was displaced with No. 4 steel messenger cable, which makes the work of erecting and adjusting the arms much easier. These mast arms have given little trouble, there having been only one failure, which was due to the heel bolts pulling out of the pole; the truss rods prevented the arm from coming in contact with the ground, and was in no way damaged, the lamp filament remaining intact. Two instances were noted where the slip socket was blown from the hood by violent wind storms. The actual number of lamp filaments broken by storms was three for the year. Four lamps were broken by stones and other missles, 57 lamps were lost by burnouts, and 35 lamps proved defective after a few hours' burning, due to the failure of the cement joint between the filament and the leading-in wires. This defect was notable only on the first consignment of lamps, and they were replaced gratis by the manufacturer.

While different makes of lamps were tried, early experience showed that they all had weak features, such as poor joints, early blackening and short life. But now these faults are almost eliminated. Six series sockets have been destroyed by excessive arcing across the film cut-outs. On the Gettysburg installation of 20 lamps, gauze film cut-outs were first installed, but they gave some trouble from jumping over and were too sensitive. They were replaced with mica strips. This 20-lamp installation receives energy from the 220-volt mains through a 3 k.v.a., variable-tap transformer and a series regulator; the 60-lamp plant has a 11·5 k.v.a., variable-tap transformer and a series regulator. The variable-tap transformers are arranged with taps at 12·5%, 25%, 37·5%, 50%, 62·5%, 75%, 87·5%, and 100% voltage. The series regulators have given excellent service, which is corroborated by the small number of lamp renewals. With regulators of this type no short-circuiting device is required for starting, the 220-volt primary on the installations being opened and closed by eight-day time switches. These switches gave some trouble during the extremely cold weather of last winter, and frequently stopped about the hour when the arc circuits were due to be cut out in the mornings. This trouble was eliminated by installing small heating elements (about 15-watt consumption) inside the clock cases.

The life of the 75-watt 60 c.p. series tungsten street lamps has been very good, in fact, much better than was expected. The average life of lamps for the Bradford installation of 60 lamps from February 1, 1909, to February 1, 1910, was about 2,300 hours. The maximum life of the oldest lamps on June 25 was 5,280 hours, and these lamps are still in service. The lamps are spaced about 400 ft. apart, and give satisfactory illumination.

Mr. Custer told the Convention that his company, after trying carbon, and then "Gem" graphitized lamps, they adopted tungstens. Their first installation consisted of 32 c.p., 5·5 amp. carbon lamps consuming 4 watts per candle, receiving energy from an alternating-current system through a constant-current regulator. Subsequently, use was made of a 4 amp., 32 c.p. graphitized carbon lamps consuming 2·7 watts per candle. In 1908 the 32 c.p. tungsten lamp consuming 1·25 watt per candle was adopted. The carbon lamps had an average life of 1,200 hours, the graphitized carbon lamps operated for about 800 hours each, while the average life of the tungsten lamps has been about 3,300 hours, excluding those that proved defective initially. About 20% of the tungsten lamp breakage was the result of causes outside of the lamp itself; namely, crosses with high-tension wires, lightning discharges, and the vandalism of small boys. Those broken by lightning are easily distinguished by a kink almost always found in the filament.

The higher first cost of the series tungsten lamp is more than offset by its longer life. It gives a better quality of light than the carbon or graphitized lamp, and a decided saving is made in the energy necessary to operate the lamp. The lamp is possibly a little more fragile than the carbon series lamp, but there ought to be very little breakage from this cause if the lamps are installed properly. In order to protect the lamp from vibration, it is better to suspend the lamp from a span wire or other flexible means of support and avoid rigidly attaching the lamp. Where a mast arm is used, it is better to have the mast arm terminate in a pulley through which the lamp may be suspended by a rope, and not rigidly attached to the mast arm. The tungsten lamp is also better fitted for operation on series circuits than the carbon or graphitized lamp, for the reason that it will withstand surges of current without injuring the filament.

In series incandescent lighting there is always some trouble experienced with open circuits, because if a lamp is broken when the current is not on the circuit, the open place must be located before the circuit may be put in operation. In case of an open circuit, it is hazardous to the life of mercury-arc rectifier tubes to attempt to puncture the cut-out films in the lamp by throwing the tube on the circuit. However, the trouble from open circuits has been minimised by the following method: A series receptacle is put on each arc panel of the switchboard, and when the arc circuit is not in operation a 4 c.p. lamp is run in series with the circuit all day from current furnished from the neutral and one of the outside wires of the Edison three-wire system. These pilot lamps give a continuous visual test of the condition of the circuit in regard to the open circuits or grounds, so that the state of the circuits can be seen at a glance and open circuits immediately detected.

In the discussion, Mr. C. I. Crippen, of Youngstown, said that series tungsten lamps had given every satisfaction to the citizens. On one occasion his company had lost every lamp on a circuit, and although this was supposed to have been due to a "cross," the actual cause was never explained.

At East Liverpool the street lighting company uses 60-series tungsten lamps on an arc-lamp circuit, and Mr. W. N. Townsend said the results were good. However, they had trouble from breakages when they placed the lamp brackets on the poles supporting street railway wires, no doubt owing to vibration or jar.

Mr. James O'Toole spoke of the Hamilton (Ohio) Municipal Plant, which used 300 tungsten lamps. Mr. Toole found these worked well, but he adopted a regulation limiting the current to 7·5 amp. maximum. He suggested that if tungsten lamps are hung in the centre of a street, they beat gas easily.

CATALOGUES AND PRICE LISTS.

The following catalogues and price lists have been received:—

Messrs. Webster & Bennett, Ltd.: "Modern Machine Tools," illustrated; Section B Multiple Spindle Drilling Machines and Sensitive Drilling Machines; Section E Horizontal Boring and Milling Machines, by the Werkzeng-maschinenfabrik Union, Chemnitz, Germany.

Western Electric Company, Ltd.: Telephone Apparatus and Supplies. A 275-paged illustrated descriptive catalogue.

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UNDERGROUND CONDUIT CONSTRUCTION FOR LARGE TRANSMISSION SYSTEMS.

By Edward W. Lake.

(*Continued from Page 230*).

DISCUSSION.

MR. D. W. ROPER said he disagreed with certain points. The first of these is the statement that vitrified clay is the best non-conductor of heat and arc-resisting material that we have. Recently I endeavoured to find some scientific data for comparing concrete with tile in specific heat, in heat conductivity, and in resistance to high temperatures. The data which I found was not given in a form admitting or ready comparison, but the experiments forming the basis of the several articles indicated that concrete construction was a poorer heat-conducting material than vitrified tile. The Commonwealth Edison Company had an experience in a burn out some time ago that illustrates this point very well. In Fig. 21 is shown three cables, on one side of the manhole, which occupied the three ducts in one vertical row on that side of the conduit. In the manhole, however, the cable was covered with split tile as mentioned by Mr. Lake. The duct material used in this conduit was of the variety known as stone pipe, which is all concrete except

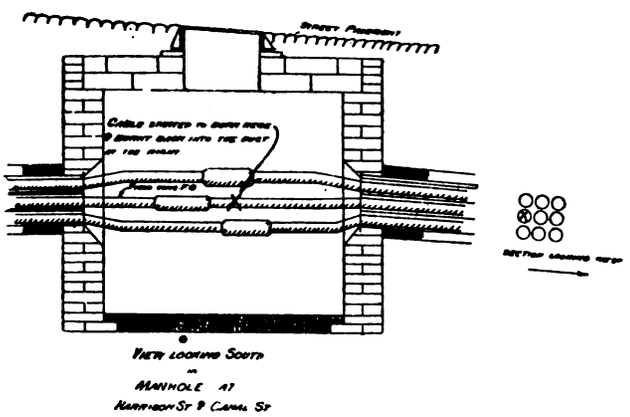

FIG. 21.—BURNOUT OF CABLE IN MANHOLE.

a small band of metal, like a napkin ring, which holds the two abutting ducts in alignment. The burnout apparently started immediately to the right of the joint, at a point inside of the split vitrified tile, and burned towards the right into the conduit. (There was no trouble whatever on any of these cables to the left of the joints.) The street had a perceptible grade downward to the right, and the conduit being approximately parallel to the surface of the street had a sufficient grade so that the melted copper and lead from the burning of the cable in the duct ran along in the conduit beyond the burn. There was one large cable in each of the nine ducts in the conduit, and the cable which was the most badly injured, and which apparnetly was the cause of the trouble, was in the middle duct of the outer vertical row. When we were able to get into the manhole, we found that the cable ended at the point just to the right of the joint where the trouble had apparently started. The rest of the cable had disappeared except for some stalagmites of lead and copper in the bottom of the manhole. This was a 1,000,000 c.m. concentric cable, carrying low tension direct current at approximately 230 volts. We saw that all of the cables in this part of the manhole, as well as those on the side of the manhole opposite from that shown in the picture, had been badly burned by the action of the arcs from the several cables. Two similar concentric cables on the other side of the manhole had also burned in two, but careful consideration of all of the facts in the case leads us to believe that the cable indicated in the drawing was the one on which the trouble started; it was without any doubt the one which was the most badly injured. In the high tension cables in the ducts immediately above and immediately below this concentric cable, all of the lead had melted and the paper insulation was so badly burned that it could be easily knocked off with a stick. These latter cables were high tension cables protected by automatic switches, and therefore, they could not maintain an arc for more than one second. The condition of the high tension cables indicated that all of the damage had been caused by the arc from the low tension cables, so that the heat which melted the lead from the high tension cables and charred their paper insulation, was conducted through two layers of split vitrified tile. Most of the split tile protecting the cables was still in position when we entered the manhole, and we could not accurately determine the condition of the cables until these tile coverings had been removed. As there were nine cables which had to be replaced, and their average cost was something like the figure which Mr. Lake gave in the paper, namely $1·25 or $1·50 per ft., we were much interested to know whether and how far the cables were injured in the conduit; that is, to determine whether we would have to replace the entire length of cable to the next manhole, or whether the cables were only burned back into the duct a few inches, so that it would be sufficient to enlarge the manhole, cut off the cables beyond the point where they had been injured, and splice on new sections a few feet in length. To settle this point we immediately made an excavation alongside of the manhole and exposed the 10 ft. of conduit adjacent to the manhole. At the time that we had the conduit exposed, the manhole was still so hot that we were unable to do any work on the cables, and as the burned ends of the cables were hanging down in an irregular manner we had not noted that there was one cable for each of the nine ducts in this conduit section. As soon as the conduit was exposed, the foreman in charge of the work, who was a man of many years experience in the business, got down into the trench and personally broke into the concrete ducts forming the conduit, so as to determine the extent of injury to the cables. The top duct of the outer vertical row was first broken into with a hammer, and the cable therein was found to be uninjured in any way except for about an inch immediately adjacent to the manhole. The foreman then broke out the next duct, and finding nothing in it, put his hand into the duct, running it back and forth to feel the condition of the duct; upon doing so he immediately said: "That duct is vacant, there is no cable in that duct at all." He then broke away the next duct in the lower row and found it was occupied by a cable which was in excellent condition. To check the foreman's statement that the middle duct was vacant, men were sent to the next manhole and found that there was a 1,000,000 c.m. concentric cable in the duct which had been declared vacant. We thereupon made a more careful examination of the pieces of the concrete pipe which had been thrown out of the trench, and broke off more pieces of the so-called vacant duct. We found by this examination that the concrete, although almost as smooth on the inside as new concrete pipe, showed perceptible signs of burning for nearly ¼ in., and that the surface material was inert, that is, friable and easily removed, like lime. The remaining portion of the concrete pipe, comprising about three-quarters of the total thickness of the pipe, appeared to be just as good and strong as it ever had been. We have here, therefore, a direct comparison between the arc-resisting and heat-conducting properties of the vitrified clay tile around the cables in the manhole, and the concrete pipe surrounding the cables in the conduit. It is the same cable, and the current in the arc was fed from the same source throughout the trouble. The cable burned for about 25 ft. into the conduit before it was disconnected, and although there was considerable flame in the manhole, due to the burning of the gases from the resinous material in the paper insulated cable, the arc was at a considerably higher temperature than this gaseous flame, and the heat from the arc was conducted through two layers of tile in the manhole so as to melt the lead off of the cables in the adjacent ducts, while it failed to injure in any way the lead or the insulation of the cable in the concrete pipe of the conduit. The tile conduit in the manhole also showed, on its interior surface, greater signs of injury from the direct action of the arc than did the concrete pipe in the conduit.

Mr. Lake spoke of the desirability of getting vitrified clay which is free from moisture, because of the difficulties which would be caused by an arc or other sources of heat in the duct or in the conduit construction. This freedom from moisture is also desirable from the opposite point of view—that is, in the case of the freezing of the ground.

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We had a case some years ago where the ducts were laid as most of our conduits are, within freezing depth—that is 30 in. more or less, of the surface of the street—and these ducts had a high percentage of absorption. Some years later, on account of the city building a sewer along that street, we had to move several blocks of that conduit, which gave an excellent chance to examine it. We found that this particular conduit was so badly broken that it could not be handled; there were a series of fractures running all through the tile like crackle ware. It apparently had been ruptured by freezing, and although it had not so broken that it collapsed and filled up the hole, it showed that the structure was considerably weakened and might have caused trouble later.

A section is shown in Fig. 9 with the ducts laid in horizontal rows separated by an inch of concrete, which the speaker called a single duct laid in tiers. It is very difficult to secure uniform thickness in spreading a single layer of concrete, and to keep the ducts in alignment after they are laid. After the trench is excavated, 3 in. of concrete is laid on the bottom, then a layer of ducts, then 1 in. of concrete and another layer of ducts; but the workmen will walk on this latter layer of tile resting on an inch of concrete which has not set, with apparently nothing to hold the ducts in alignment except gravity and the friction on the concrete. The result is that with that kind of construction, instead of getting the expected 3½ in. of opening, it is found that, in attempting to pull a 3 in. mandrel through, it cannot be done; in fact, it is sometimes difficult to get a 2½ in. mandrel through. The question of alignment is one of the hardest problems in the single duct tile construction, and our experience is that we have less difficulty drawing our cables into 3¼ in. round section concrete pipe, which is in more accurate alignment, than we have in 3½ in. square bore vitrified tile.

Occasionally we have had difficulty in drawing cables into the tile ducts, and the foremen have brought sections of such cables into the office which looked as if they had a square section; that is, the ducts would be offset in one place so that the cable would be squeezed and flattened, and in another place the cable would twist or the alignment would be offset in the other direction, resulting in a section that looked like a square cable with rounded corners—not 3½ in, square, but something much smaller than that—2½ in. or thereabouts.

The statement was also made that the square section offers less resistance when two or more cables are being drawn in. That is the reverse of our experience. The men on the ground who have actual charge of installing these cables say that the large cables, from 2 in. to 2¾ in., are drawn into the ducts with apparently less friction with the square section than with the round section, their theory being that the arc of contact with the cable and the duct is less when the cable rests on a flat surface than when it rests on the inside of a cylindrical surface. I am speaking in both cases, of course, of conduit section in which one meets with no difficulty like the offset ducts that I spoke about a few minutes ago. Where we have two or three or four single cables pulled into one duct, however, the cables apparently assemble so that they fill the larger portion of the duct, but they become wedged in there, and then as the pulling rope turns—and it always does unwind somewhat as the strain is applied—that twists the grip which is fastened to the cable and twists the cable in the duct. When this twisting action occurs, these cables have to move on each other and assume a new relation with respect to each other. That does not occur where we have a round duct construction, and where the cables can twist in the duct and always hold the same position with respect to each other.

In the illustrations showing the laterals there were several suggestions, one of which included a fibre duct or pipe, surrounded by iron pipe. As I read the picture, however, it appeared that these lined iron pipes were all intended for small cables like the single comparatively small cable that was shown in the laterals. That appears to be an excellent idea, but I should be glad to see how to apply this idea practically to a case where it is desired to pull four cables into the lateral, and the cables nearly fill a 3 in. round pipe. That means that you have to maintain a 3 or 3½ in. section throughout the length of the lateral instead of having it 2½ or 2¼ in. through part of the lateral.

Among the suggestions was one which included a square conduit for certain kinds of cable, and a round bore for certain varieties of cable. The difficulty I have found in laying out conduit lines is to tell just what particular duct in the conduit is going to be used for high tension, and which for low tension or some other variety. It is very difficult indeed for us to tell in which section of the city our growth is going to be, where the next large customer is to be located, and what kind of current he will want. We even find considerable difficulty in determining, with any degree of accuracy, the size of conduits—that is, the number of ducts that we should instal in some particular street. I remember one case where we did not have a conduit within several miles, but as one of our friends was building one, and asked us to build a joint conduit, we took a chance and asked him to build three ducts for us, although we had no conduit within two miles of it. Within three years we had to instal four additional conduits in that street, so that we had seven ducts where we thought three were enough to last us five or ten years.

The speaker, in referring to single duct tile, did not bring out one of its good points, which is one of its most valuable assets for conduit work, and that is the ease with which a tile conduit line can be broken out and repaired. We frequently have a case of trouble, either real or fancied, where we have to, or do, dig up the conduit line to repair or to examine the cables. In some cases we have to break out the conduit to allow the installation of a water pipe or sewer, or something of that sort. With some of the multiple duct sections, the replacement is very difficult, and almost impossible without first removing the cables. With the single duct vitrified tile, however, you can, by the aid of split tile, lay the same identical conduit section around the cables which are already in the conduit, and then lay the standard single duct straight tile for the rest of the ducts.

MR. W. B. JACKSON: I wish to ask Mr. Roper if it is the custom of his company to carry out three or more cables from a single lateral? He spoke of that as being one objection to the lateral shown by Mr. Lake.

MR. ROPER: We frequently instal several cables in one lateral; they are comparatively small, however; for instance, in our low tension work we instal three No. 6, three No. 0, or three No. 0000 cables in one lateral. If those three cables occupy one duct in the conduit, we continue the whole construction and put the three cables in one lateral pipe up the pole. In our 60-cycle work we follow the same practice, and instal as many as four No. 6 or four No. 0 cables in one lateral pipe up the pole, which is the same construction that we have in the conduit.

MR. F. W. DARLING (Clay Product Company): Mr. Lake mentioned the round bore single clay conduit. It is true that in the manufacture of conduit the round single ducts require considerably less care. Suppose that we have rejections, that is, cull out in the manufacture of square single tile, 10% of them; in the round single ducts we can cut the amount down to almost 2%. If there is that difference in the manufacture of the tile, there would naturally be that difference in the cost of the two. This is probably due to the fact that in burning the round single duct, having a sort of arch construction, although of clay, it does not give way under the strain of manufacture and burning as the broad side of the square duct does. Also, it is reinforced by the extra thicknesses of clay on several corners instead of having a flat side and equally thick corners. In regard to the voids in connection with the square duct. After Mr. Lake sent us that letter asking for information relative to the manufacturing the square tile with a very small radius on the outside corners, we attempted to make some, using an old die and filing out the corners. We found that such tile could be easily made, but that if the clay is run stiff and thick, requiring but a short time in the dry room and thus reducing the cost, it roughs up or scales on the corners. That does not injure the tile, however; the outside is simply roughened up, with a little peeling and scaling. The inside remains perfectly smooth. Of course, the inspectors might infer that those cracks went through.

A well vitrified clay conduit, in its manufacture, is burned to a temperature of approximately 3,000°. It is supposed to stand a temperature of about 4,000° before giving way.

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Under usual and ordinary circumstances, cement products cannot stand a temperature of over 1,800° without having the line salts broken up and dissipated, reducing the cement mass to a condition about as friable as soft plaster. With this in mind, it seems hardly fair to accept the single instance which Mr. Roper mentioned as a proof of the test. It seems as if we ought to be able to find another reason for the destruction of the cables in the manhole while they maintained their contact in the duct lines. It occurs to me that an explanation may be found from the fact that the duct lines had a gradient up to the point where the burnout occurred. This being true, the instant the temperature was raised at the point of burnout a draft would be generated from the conduit line towards the manhole. As the burnout extended along the cable, the path of the draft being determined previously, this current of cool air would doubtless increase considerably and carry the heat out of the duct, acting as a flue. That this was true to a certain extent is shown by the fact that the residue from the burnout was found in the manhole, and a further proof would be that adjacent cables in the manhole were burned inside of the clay conduit by the prolonged temperature thus maintained. I am, in fact, surprised that the clay conduit in the manholes did not give way under the temperature thus produced. It is, of course, admittedly important, with our present knowledge, to get a substance for conduit which will be practical, and yet withstand the terrific temperature produced by a burnout, but the tests which we have made, comparing vitrified clay conduit with cement and fibre products, show conclusively that the clay conduit will withstand temperatures varying from 1,000° to 2,000° higher than either of the other substances.

MR. LAKE: The matter of concentric cable burnouts is something that is unfamiliar to those of us who are interested in street railway distribution here in Chicago. I am inclined to agree, however, with Mr. Baird, that the results might have been the same if the burnout had occurred in a vitrified clay duct. At any rate, the 1 in. of concrete between the cement pipe is certainly a desirable feature. The matter of laterals which we use in street railroad work and the size of cable is confined almost entirely to 100,000 and 500,000 c.m., ordinarily; 350,000 c.m. is also largely used. Those are the three sizes of single cable which would be used in the construction of laterals. It is possible, however, to secure fibre in the larger sizes, and, of course, possible to secure the iron pipe to protect the fibre up the pole of any size which might be desired. Fibre can be obtained of any size up to 8 or 12 in., but I believe the latter is the limit that is manufactured at the present time. Four-inch pipe and its lining would be thoroughly practicable, and the lining would not have to be very thick.

ELECTRICITY IN THE CONGO.

Herr Emil Zimmermann, writing in the Berlin *Kolonial Zeitung* on the ore deposits of Katanga, describes it as the richest belt of copper mines in the world. He says that it was expected that the railway would be completed as far as the Star mine by next month, then "an electric power station will be erected on a little river about seven miles distant. There is a waterfall which will furnish sufficient power to light the whole underground workings electrically, and also to instal electric haulage. I am convinced that great things may be expected from the Etoile du Kongo mine in the near future. Perhaps we shall have within a year a small town with 2,000 Europeans, supplied with electric light, comfortable dwellings, and developing a brisk trade. At present there are working in the mine about 400 men in day and night shifts; work is concentrated chiefly on development, so that the raising of the ore can be started to the utmost capacity as soon as the great machinery now in transit from Europe and America is erected."

MANCHURIA.—The South Manchuria Railway Company are laying down a large silk spinning factory at Dairen, where about 200 reels will be installed. Both electricity and gas are to be used in the factory.

STORAGE BATTERIES IN ARMY AND NAVY SERVICE.

By E. L. Reynolds.

The United States Army and Navy have found occasion to adopt in one form or another, practically every electrical device known to the trade. It is, therefore, not surprising that the storage battery, which is used so extensively in modern applications of electricity, should have found a position of the greatest importance in the service. In view of this fact it is of interest to review some of the recent uses of the storage battery by our government, with a brief history, and some details of construction and operation.

The principle of the storage battery was discovered in 1801 by Gautherot, who experimented with platinum electrodes immersed in salt solution. Practically nothing was done to develop the principle until 1860, when Gaston Planté, a Frenchman, experimented with a cell consisting of lead strips immersed in dilute sulphuric acid. He discovered that each time the cell was charged and discharged, the amount of current given out on discharge was greater; and, further, that by charging the cell in reverse direction each alternate time, the capacity was rapidly increased. He amplified this process and was able to construct plates having sufficient capacity to make them a commercial possibility. Most changes and improvements of the storage battery since that time have been along these lines. Hence Planté is justly considered the inventor of the storage battery.

Planté's method of charge and discharge in reversed direction caused an increasing deposit of active material on the plates due to peroxidising of the raw lead, thus resulting in an increase in capacity. This method of forming active material from the raw lead was slow and difficult and led to the experiments of Camille A. Faure, who, in 1881, patented a process of making storage batteries by covering the lead surface with lead-oxide paste instead of forming the lead oxide electro-chemically as in the Planté process. One charge only was then required to put the plates in condition to produce their final capacity. In the United States, Charles F. Brush developed, simultaneously with Faure, the same process, so that in this country, Brush is considered the inventor and his patents controlled the process in America.

All lead storage batteries are to-day produced by one or both of these processes, so that they are of the Planté type, of the Faure type or of a combination of both types, in which case one plate, usually the positive, is Planté and the other Faure. Storage battery practice of to-day has, therefore, evolved through continuous mechanical and chemical improvements from the plates originally made by Planté and Faure.

The commercial use of storage batteries in this country on a large scale began about the year 1893, when the Electric Storage Battery Company, after five years' research, placed the chloride accumulator on the market. This company secured control of many of the patents of the storage battery art. From this time on storage batteries came into greater and greater use, the most noticeable applications at first being in connection with isolated electric plants, Edison lighting systems and electric street railways.

In 1896 the Edison Electric Illuminating Company, of Boston, installed a battery of 8,000 amperes. This was the first big step in the use of storage batteries on an extremely large scale. Since then most of the larger Edison plants throughout the country have installed enormous batteries so that at present date there are 165 such plants operating, aggregating 215,000 kw. hours. The use of large batteries in isolated plants and street-railway plants has developed simultaneously so that there are now in operation approximately 1,200 such plants, aggregating 400,000 kw. hours.

The most prominent installation of batteries to date is that of the New York Central and Hudson River Railroad, which company is now operating or installing 2,692 cells in nine batteries, aggregating 60,000 h.p. hours at the regulating rate, in connection with the electrification of the steam road in New York city and vicinity.

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The latest extensive use of storage batteries in government service is in the Navy, where the night sights are operated and guns fired by electric current. For several years dry primary batteries have been used for this purpose. A small galvanised iron box is fastened to the gun mount and in this the dry cells are placed. After experimenting with storage cells in the recent cruise around the world, it was demonstrated that they meet conditions better than the dry cells. The care of the storage batteries, as will be seen later, is comparatively simple, and with this care the cells are always in a condition to instantly respond to demands upon them. A capacity of over 20 ampere hours at 10 volts could be squeezed into the small galvanised iron boxes—which capacity is ample to meet the requirements for several days under the most exacting conditions. As a result of observation of storage cells during the world's cruise and other data available, a storage battery was designed especially for this work, and a routine of operation carefully worked out. Last year over 1,000 of these batteries were placed in service. In the construction the following points were determined to be advisable.

Plates are of the well known Exide type, grouped together with a substantial pillar strap and separated by grooved wood separators properly treated to remove all injurious substances. These plates are mounted in rubber jars and supported by ribs in the bottom of jar. Each cell is covered with a rubber cover supplied with a suitable vent and filling plug and having holes for exit of terminal plugs. Vents provide for return of condensed spray at vent openings. The five cells constituting the set are mounted in one wooden box of the following maximum outside dimensions: Length 8⅜ in., width 7 in., depth 7 7-16th in. to top of vent plug and terminals. The jars are placed in the wooden case and embedded in a suitable compound to make them integral with the case and prevent water or other liquid running down between the cells and the case. Four intermediate connection straps are burned to the projecting terminal posts of the cells, connecting them in series and the entire top is filled in flush with the top of the case with waterproof insulating compound, leaving only the two end terminals and the vent-plug extending above the even surface of the compound. The terminal posts are supplied with lead-alloy-encased connector clamps, each terminal post being provided with a square projection to receive square recesses in the terminal cable lug.

The storage battery has made the submarine possible. There are now approximately 25 of these boats in service in the Navy and this number will undoubtedly be increased. The plate generally used is of the Exide type—a pasted plate similar to that in the gun-firing batteries, but much larger and heavier. The usual battery consists of 60 to 120 cells with discharge capacity from 500 to 900 amperes. The necessity of obtaining as much capacity as possible with minimum weight and space, has been well met by the storage batteries in service, and the details of installation, insulation, drainage, ventilation, have been so developed as to reflect the greatest credit upon all concerned in the design.

In the Army storage batteries have for many years been used in various fortifications as a reserve to the lighting plant. These batteries consist usually of 64 cells to operate on a direct current 110 volt system. It would seem difficult to exaggerate the importance of these fortification batteries. In time of engagement their serviceability in case of accident to the generating plant would enable light to be obtained, thus ensuring the full fighting efficiency of the fort. Storage batteries in this work are of additional value in carrying the load when this load is too small to be economically carried on the generating plant, which results in considerable saving in fuel and labour. In some cases it has been found necessary to operate the generators only once a week, the storage batteries taking care of the load the rest of the time. It is thus seen that the economic and emergency features are of great value.

That the element of insurance of service is appreciated by others than the Army is shown by the fact that practically every great Edison Lighting Company of the United States has installed enormous batteries. The investment in storage batteries in the New York Edison service alone is considerably past the million dollar mark, and shows what the business man and engineer is willing to pay for insurance of service. Of course, the fortification batteries are small compared with these but their usefulness in time of war could not be valued in money.

The Army also has found large use for batteries in connection with telautograph machines at various fortifications. It seems that these electrical devices, which reproduce written instructions at distant points, demand a more constant voltage than that found in the average generating plant. Storage batteries are absolutely constant in voltage from moment to moment, and have been installed in great numbers for this work.

The field wireless outfit for the Army demands a storage battery for most efficient operation. For this purpose many portable batteries similar to the gun-firing batteries of the Navy have been placed in operation. These batteries have a capacity of 60 ampere hours at eight volts, they weigh 47½ pounds and in size are 12·6 in. long, 6·4 in. wide, and 9 in. high.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

ANSWERS.

Question No. 1223.—How far can underground cables replace overhead h.t. cables? What system is best for such underground cables, and what failures (due to internal and external causes) are most likely and most serious. Does earthing the system affect the problem? Give information on the cost and life of underground cables (actual data if possible). How are future developments of voltage, land value, population, etc., likely to affect underground transmissions?

Answer to Question No. 1223 (*awarded* 10*s.*).—Underground cables are alone permissible in densely populated districts owing to the danger to life which would arise from overhead transmission in such cases, and to the difficulty of erecting the latter system in towns. Underground lines will never replace cross-country overhead lines for the simple reason that there is no necessity for them, nor advantage accruing from their use such as would compensate for their much greater capital cost. In cities and their near environs underground transmission is essential for pressures exceeding 500-1,000 volts. It is commercially impossible to use such high pressures underground as are employed overhead for, whereas the air insulating overhead lines, phase to phase, costs nothing, the rubber or paper insulation of underground cables is very costly. Moreover, there are limitations to the overall size of underground cables. 20,000-25,000 volts seems to be the present day limitation to the pressure carried by underground cables, though there is no doubt that 40,000-50,000 volts could be fairly economically and safely dealt with should occasion arise. The margin of safety is considerably less in extra high tension cables than ordinary high tension lines (5,000-10,000 volts, say).

It is generally supposed, in this country, that high tension cables are best "solid" laid, *i.e.*, laid in wooden or earthenware troughs and completely covered by molten bitumen. In colliery and similar installations armoured cables, laid direct in the ground and covered by a wooden plank, are frequently employed. Where it is necessary to be able to make extensions and repairs without digging out the cable, the conduit system must be employed. This method is considerably employed in America: its disadvantages are—inflexibility, a number of cables being

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confined to one route, which cannot be best for all; imperfect cooling of cables; liability of a burn-out on one cable to affect its neighbours; liability to collection of moisture, and hence electrolytic damage.

Failures due to "external" causes may be caused by mechanical injury (*e.g.*, a blow with a pick) or by the heating or burning set up by a fault on a neighbouring cable. Electrolytic damage to the cable sheath may also be classed as an "external" cause of damage. The "internal" causes of breakdown include badly made or badly insulated joints (a very common and quite inexcusable failure); excessive current density, causing undue heating; and excessive pressure, causing puncture of the insulation. It is assumed that the latter is not of poor quality. Pressure surges are generally due to lightning striking some overground portion of the circuit or to resonance surges. The latter often occur at the moment of switching "on" the cable; they may be avoided by charging the cable gradually through a water resistance. The use of oil switches, which possess the property of breaking the circuit at the zero of the E.M.F. wave, avoids dangerous oscillations on switching "off" cables. In the past damage has no doubt been done to cables by the act of switching "off," but, the fault not being discovered till the cable was next put into duty, the breakdown was attributed to the switching "on." To avoid damage to underground lines by lightning, spark gaps and earth paths should be placed wherever overhead lines are connected to the subterranean system.

With care, there need not be more than 1 or 2 faults per 100 cable mile-years on a h.t. underground cable system. Of these some 50% will be due to true breakdowns, all more or less inexplicable, while some 30% will be due to "external" causes, and some 20% to faulty joints. By taking care to provide ample insulation and *to completely exclude air* most of the joint failures could be avoided.

If certain lengths of cable are found to be specially liable to breakdown it is often sufficient to connect a surge gap and earth resistance to the dangerous section of line.

A life of 20 years should readily be obtained with any good modern cable, liberally rated and carefully laid. In general it is best to earth the cable sheathing; though chemical and electrolytic corrosion of the latter are thus facilitated, trouble due to induced currents in the sheath are avoided; these remarks do not apply to the solid-laid system.

The cost of h.t. underground cables is mainly dependent on the voltage (*i.e.*, on the insulation) concerned. Fortunately the cost does not appear to undergo any disproportionate increase for voltages from 25,000-50,000 volts, so that cables for the latter pressures may become common during the next decade. The reader will find some interesting information and curves concerning the cost of high tension cables in "Proc. Amer. Inst. Elect. Engrs.," Vol. 28, pp. 111-113.

Merz recommends 0·10-0·15 sq. in. as the most economical copper section for 3-phase cables, the supply volts being chosen so that a cable of this size will transmit the desired power with suitable current density and efficiency. Where the conduit system is employed it may be advisable to use 0·25 sq. in. cables (or even larger sections) in order to reduce the number of ducts and so promote cooling. An armoured cable (taped round lead and round sheathing) costs some 7½% more, including laying, than does a solid laid cable of equal capacity; as a rough guide it may be taken that armouring a cable costs £100 per mile.

As the land value and population of cities and their suburbs increase the necessity of employing underground cables will become more and more marked in those districts. As cable makers are already prepared to turn out underground cables suitable for 50,000 or even 75,000 volts there is no likelihood of the development of underground cables being restricted by the use of increased pressures, for it must be many years ere voltages exceeding 20,000-30,000 volts will be needed for city and suburban work. For hydro-electric schemes where specially high pressures are necessary overhead transmission will continue to be used.

The figures quoted above show that e.h.t. underground cables are now as reliable as the other links in a thermo-electric generating and distributing scheme; the damage done, and the time required to repair it, by a cable breakdown depend on whether adjacent cables are affected by the fault. So far as the faulty cable is concerned, the pressure usually determines the breakdown but the power "behind" the fault determines the nature and extent of the damage wrought.—"L. C."

MAGNETIC GALVANIZING.

Owing to the lease of their works at Chelsea having expired, and to the large increase in their business, the Cowper-Coles Galvanizing Syndicate have secured much larger works known as Magnet Galvanizing Works, Bow Bridge, Stratford, E. A large up-to-date plant is being installed for their patent regenerative galvanizing, which will be worked in conjunction with their improved process of hot galvanizing (Cowper-Coles Patent), so that the company will be in a position to undertake the galvanizing of all classes of work, including tank work and tubes. At the present time, they have orders in hand for boiler tubes for the English, French and Italian Governments.

BOOK NOTE.

"The Encyclopædia Britannica" has been taken over by the University of Cambridge, and a new and complete edition (the eleventh) will be issued by the Syndicates of the University Press towards the end of this year. It will be practically a new work, for the revision has been most thorough, and a heavy percentage of the articles have been re-written. From the precautions taken, it is evident that the "Britannica" in its new form will be at once a better balanced and a more useful work than any of its predecessors.

THE ROBERTSON AND OSRAM SOCIAL AND ATHLETIC CLUB held their fifth annual sports at the Latymer Upper School Grounds on August 27, a capital day being spent. In the 60 yards' flat race for girls there were eight heats, and there was a very strong field. The winners were: (firsts), Misses Roughton, D. Pearce, M. Best, C. Leach, L. Baker, D. Wise, L. Scrivener, E. Pearce, F. Redding, W. Chant, E. Rigby; (seconds), Breaden, F. Crittenden, F. Le Grove, M. Alston, B. Cosier, L. Hiscox, L. Holmes, Ashby, Eales, A. Harrison, and E. Lenthard. In the semi-final there were three heats, the winners being: (firsts), Misses Eales, Baker, Redding; (seconds), Roughton, Pearce, and Chant; (thirds), C. Leach, Ashby, and Senthard; while in the final Miss Roughton came in first, and Misses Redding and Le Grove second and third. For the 100 yards' "Hirst" challenge cup championship there were 13 entrants, the winners of the first heat being Messrs. A. Robinson, E. Robinson, and Eve; and of the second, G. Freeman, V. Clark and G. Latham. In the final, Mr. A. Robinson carried off the cup, E. Robinson and Page coming in second and third. Precisely the same order occurred in the 100 yards' handicap race. The threadneedle race for girls was worked off in seven heats, and in the final Miss Scrofield came in first, followed by Misses Redding and Horton. In the veterans' 100 yards' handicap, Mr. Cahill beat a field of five, Mr. Heden coming second. In the relay race, the General Electric Company carried off the "Wilson" challenge cup from the Robertson and Osram team, winning by 36 yards. In the tug-of-war, the "Sheppard" challenge cup was captured by the Robertson's team, who overcame both the General Electric Company and the Osrams. The egg and spoon race for girls proved an exciting event, or, rather, series of events (for there were 11 heats, a semi-final, and a final), in which Misses Chant, Best and Record secured respectively first, second and third places. In the boys' 100 yards' handicap race, J. Wills and J. Toley carried off first and second prizes. Even during the tea interval enthusiasts were at work, a capital five mile scratch race being run, Mr. Bailey coming in first and Mr. Bulsworthy second. Mrs. C. Wilson kindly presented the prizes.

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INCREASED SAFETY OF ELECTRICAL MACHINERY.

Some comfort may be drawn from the report of the Chief Engineer to the British Engine, Boiler and Electrical Insurance Company, Ltd. Passing over much interesting matter relating to boiler and engine inspection, we come to the section dealing with inspection and insurance of electrical machinery. Premising that depression in trade had reduced the value of the company's business in this branch, the rate of increase being lower than in 1908, Mr. Michael Longridge says that breakdowns of dynamos were absolutely fewer than in any previous year. The rate of breakdowns among various classes of machinery are put down as follows: Dynamos: D.C., 1 in 17·2, A.C., in 1 in 17·5. Motors: D.C., 1 in 8·2; A.C., 1 in 9·5. Dynamos and motors: D.C., 1 in 9; A.C., 1 in 9·7. Starters and controllers: 1 in 25. The percentage of decrease as compared with 1908 was for dynamos 22·0, motors 6·2, starters and controllers 7·5; while the decreased cost of repairs were respectively 43·8, 1·8, and 18·8%. In a number of extremely valuable tables, Mr. Longridge gives details of the proportions of various parts of dynamos, motors, starting switches and controllers which broke down. We must refer our readers to the report for these details, but it is abundantly clear not only that systematic inspection is bearing fruit, but that better construction and more competent handling are adding greatly to the safety of electrical appliances.

We will now quote from Mr. Longridge's report certain instructive cases of breakdown:

A few of these breakdowns are described in the following paragraphs.

1.—Four pole series-wound 16½ h.p. motor, 2 years old, receiving current at 440 volts from the two outer wires of a three-wire continuous-current system, with the middle wire earthed. The motor was attached to a 4-ton stationary jib crane. One of the Company's inspectors was sent for to find out why the craneman got a shock, as he averred he did, when he put his foot on the brake.

The inspector found that when the man, standing with one foot on the ground, put his other foot on the brake, he at the same time pressed with his knee one of the cables from the controller to the motor against the edge of an iron bracket which carried the supply cables. The rough edge of the bracket had gradually worn away the insulation which had previously guarded the copper conductor from the iron. Consequently, when the man pressed the cable against the bracket, the bracket, the crane, and the man's body formed a 220-volt circuit between the outer and the earthed middle wire of the supply. The moral is that all the iron-work of the crane should have been efficiently earthed.

2.—Compound-wound six-pole continuous-current dynamo, about 2 years old, giving 500 amperes at 500 volts when running at 375 r.p.m.

One Saturday evening, when the load was about 200 amperes, the shift engineer saw flashing, and solder thrown from the commutator lugs. He at once stopped the machine, and, finding nothing wrong, restarted it and sent for the Company's inspector. The inspector called early on the following Monday morning, but was unable to make any examination, as the dynamo was running. Seeing it running well, and learning that it had so run for five hours after the stoppage on the Saturday night and for six hours on the Sunday, he left. Soon after he had gone the sparking recommenced, and the dynamo was shut down. When the inspector examined it he found some solder melted out of four of the commutator spokes, and wedged in behind them a ferrule ⅞ in. diameter, by ½ in. deep, such as might have come off the handle of a file or soldering iron. As it could not be got out without disconnecting and bending back some of the armature conductors, it must have got in before these connections were all soldered up. The probability was that it had dropped off the soldering iron or a file in use when the machine was made, two years before, or when it was repaired a short time afterwards. It is extraordinary that it had not caused damage sooner.

3.—Semi-enclosed shunt-wound four-pole motor, rated to give 11·5 h.p. at a speed of 800 r.p.m., with continuous current at 500 volts. The motor was fixed in the fitting shop at a colliery, to drive machine tools. Soon after starting one morning the armature current went to "earth," and the fuse blew. The fault appeared to be between the ends of the coils and the cast-iron drum for supporting the end connections to the commutator spokes. When the windings were disconnected three dead mice were found jammed between the ends of the winding drum and the commutator spokes, and a fourth inside the armature, while the ends of the windings were burnt and blackened with their blood. The unfortunate creatures, in search of warmth, had evidently crawled into the armature during the night, and in trying to escape when the motor started had been flung by centrifugal force to the periphery of the cavity behind the commutator spokes. Assuming the weight of a mouse to be 1 oz., the pressure upon each from centrifugal force would be 6½ lbs., which may have been sufficient to squeeze the blood and liquid from their bodies and thus destroy the insulation of the conductors.

As a safeguard against a similar accident, the owner, at the inspector's suggestion, covered the openings in the end plates with fine wire-netting.

4.—Three-phase alternating-current motor, 4 years old, with wound rotor fitted with slip rings, giving 350 h.p. at a speed of 195 r.p.m., with current at 500 volts.

The motor was coupled by spur gearing to the crank shaft of an old hauling engine, from which the connecting rod had been uncoupled. Its speed was regulated by a controller of the barrel type, immersed in oil, which cut in or out resistances in the rotor circuit. The motor and controller were placed in the engine-room below ground, close to the down-cast shaft, and separated from the up-cast by wooden doors. The room had a wood floor, and was surrounded by virgin coal. Owing to some defect, possibly a short-circuit between contacts of different phase within the controller, the oil in the box and the resistance cables leading from it were set on fire. The heat was sufficient to vaporise the oil, which burnt furiously and set fire to the doors dividing the up-cast from the down-cast shaft, thus short-circuiting the ventilation of the pit. The sand provided for the extinction of fires, in accordance with special rules issued in 1905 for the installation and use of electricity under the coal Mines Regulation Act of 1887, was useless, as it would not smother a vertical or suspended cable, but the fire was put out before the coal became ignited. Whether one of the chemical extinguishers would be effective in such a case remains to be proved, but at first sight it would seem more promising than sand.

5.—Three-phase alternating-current motor of 120 h.p., running at 385 r.p.m., with current at 440 volts, 40 periods per second from a supply company's mains. The motor was put down in 1908 to drive drawing machinery by a spur pinion, 7 in. diameter, carried on the overhanging end of the rotor shaft and geared with a wheel 29 in. diameter. It was connected to an auto starter or transformer for reducing the voltage of the starting current.

One morning, in October, 1909, the motor refused to get up speed. On examination, one of the coils of the transformer was found burnt. The transformer was sent to a local shop to be repaired. There the company's inspector saw it, and found the insulation of one of the coils, particularly of the inner section, roasted and charred, but showing no sign of metallic short-circuits. He came to the conclusion that the damage had been done by holding the starting switch on too long when trying to start the motor. He ordered the coil to be re-wound.

In the meantime a starter was borrowed from the supply company, and coupled up. This worked satisfactorily till December 4, a Saturday, when the repaired starter was put back. It failed to start the motor. The borrowed starter was therefore replaced. On the following Saturday, the 11th, after a diagram of the connections had been obtained from the makers, the original starter was again put in and another attempt made to start the motor, but

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without success. On the 13th the company's inspector was sent for, and arranged to attend on the following Saturday, the 18th. On the 16th and 17th, however, several attempts to start with the borrowed starter proved abortive, though the speed was finally obtained. On the 18th the inspector attended according to promise. The repaired starter was again put in, and, after some alteration of the tappings from the starter to equalise the voltage drop on each phase, was able to start the motor. After starting and stopping it some 20 times, the inspector left, thinking he had overcome the difficulty. On the following Monday morning, at 6 a.m., the motor started without trouble, but at 8.30 it again refused to get up speed. The inspector, calling a little later, found the supply company refixing the borrowed starter, and with this the motor was re-started at 1 p.m. The inspector waited till 5 p.m., when the machinery was stopped for the day, but was then unable to start the motor with the borrowed starter. He therefore had the triple-pole oil switch taken in pieces and carefully examined it, testing the stator and rotor coils, and examined all connections, had the protecting shields taken off the sides of the stator, examined and gauged the air gap, and found it about 1-16th in. all round. On switching on the current, the rotor began to turn slowly, and then seemed to be lifted and forced against the upper part of the right-hand side of the stator (looking from the driving end), and there to stick. On taking the bushes out of the bearings, the upper halves, especially that at the driving end, were found worn sufficiently to allow the shaft and rotor to be forced into contact with the stator by the pressure exerted by the teeth of the driven wheel upon those of the pinion on the end of the rotor shaft. The bearings were adjusted, and no further difficulty in starting has been experienced.

The reason why the motor started with the borrowed starter but not with its own probably was that the former allowed a higher voltage than the latter. The reason why it started on some occasions and not on others is more difficult to suggest. Probably there were some positions of the machinery beyond the driving pinion in which the resistance to motion and, consequently, the pressure on the pinion teeth was greater than in others. Possibly, also, the rotor or stator cores may not have been quite circular. Whether the rotor was brought to a standstill by friction against the stator core, or by loss of torque owing to weakening of the revolving field by the unequal width of the air gap, is uncertain, but, be this as it may, the moral is quite clear, and it is this, that the shields over the stator windings of alternating-current machines should be so arranged by piercing or otherwise that the width of the air gap may be visible. In the case referred to, neither the clearances between the shaft and its bearings, nor between the rotor and the stator could be seen without partially dismounting the machine, and thus much valuable time was lost through seeking for the cause of the trouble in the dark.

MERSEY RAILWAY.

Mr. James Falconer, M.P., presided at the half-yearly general meeting and said that he had again to congratulate the shareholders upon the satisfactory results of the working of the railway. There had been an increase in the receipts, and a decrease in the expenditure, so that there was a net advantage in this half-year compared with the corresponding half-year of £2,699. If they took the whole year's working they also showed improved results, and an increase compared with the previous twelve months. It was interesting to review the result of the working of the railway during the last half-year under steam compared with the present half-year. For the last half-year of steam working they carried 3,357,000 passengers, while in the half-year with which they were now dealing they had carried 7,395,000, or an increase of over 4,000,000, equal to 120%. Dealing with the same period their receipts showed an increase from £29,470 to £54,653, or equal to 85%. The reason for that increase was the obvious one which had been made apparent half-year after half-year ever since they adopted electrical traction, namely, the affording of greater facilities to the travelling public between Liverpool and the Wirral Peninsula, where there had been a considerable development which was still continuing. Dealing with the accounts the Chairman pointed out that the balance to the debit of the revenue account on the last occasion was £16,192, which they had been able to reduce to £11,821.

With regard to the remainder of the debit balance which stood in front of the payment of interest upon their Debenture stocks, he wished to explain that one of the objects of their Bill which they had promoted in the last session of Parliament, and which had received the Royal assent, was to enable them, as from the end of this year, to treat that debit balance as applicable to capital, with the result that as from January 1, 1911, the net revenue from the working of the railway would be applicable immediately for payment to the holders of their First Debenture Stock, who had waited so long and so considerately for a return upon their money. After they had met the claims of the First Debenture holders they hoped to be able to proceed to pay the interest at an early date upon the other issues. This position was the first fruits of the policy which was begun in the year 1903, when they inaugurated electric traction. He moved the adoption of the report.

A discussion followed, and Mr. Pringle, of Edinburgh, congratulated the board, and thanked them for what they had done in bringing the company to its present position, and also for securing the new Act of Parliament to wipe out the debit balance. That was the first meeting he had had the opportunity of attending, and he was glad to see from the diagram the directors had published in the report, which was a most useful thing, that during the last 15 half-years they had not gone back, but had shown continuous progress. Some railway companies had their lean years and their fat years, but this company from the time it started to progress had not had a single setback. He looked forward with confidence to the future. As he understood the position the 1866 Debenture Stock would receive its interest first, then the 1871, then the 1882, and then the B stock, and he trusted as a large holder of Preference Stock that, after weary and patient waiting, that class of holders might before long also come into the receipt of a dividend.

He then made reference to a subject which was brought forward by one of the shareholders at the previous meeting in respect to the sale of the Mersey Railway Company to one of the big railway companies, and said that he approved of the reply which the Chairman gave upon that occasion, that, while they were continuing to progress half-year after half-year, it was not for them to go about offering themselves for sale to other companies. Of course, if a reasonable offer should come from one of the large railway companies the directors would, he supposed, consider it, and he knew that it was a matter of common supposition that one of the big railway companies had their eye upon them, but time was on their side, and the longer the large railway company waited the bigger would be the price it would have to pay.

Mr. Gardner Williams expressed satisfaction at the dividend possibilities of the future, and said that he thought that the Bull point in their favour would be the question of the electrification of the Wirral Railway Company's system, which would develop Hoylake and West Kirby, where building would further increase. A through electrical traffic over the Wirral and Mersey systems would be a great advantage to both companies. He said that it would be premature to consider any question of the sale of the raiwlay now. Five years hence would be quite soon enough, when they were in a much better state, as they were bound to be, and could command a higher price.

The Chairman replied, and said, as to the question of any sale or agreement with any of the big railway companies, he was still entirely of the opinion which he expressed on the previous occasion, and which had been endorsed by Mr. Pringle, that while they were doing as well as they were it was not desirable that they should go about offering themselves for sale.

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THE
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Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

Terms for displayed advertisements may be had on application.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being under taken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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STREET LIGHTING.

Much capital is being made of the fact that the Gas Light & Coke Company have signed a contract with the City of Westminster for lighting a certain area with gas, thus displacing 66 arc lamps hitherto supplied with current by the St. James's Electric Light Company. There are quite exceptional circumstances to explain this case, and it must be remembered that for some time to come Westminster will still be lit by 1,135 electric arc lamps. In this case the gas company makes use of mains already laid, and apparently foregoes all charges on capital account, as the charge for gas is only to be 10½d. per 1,000 feet, while, according to published returns, the actual cost of production appears to be 1s. 10d. per 1,000 feet. Of course, there may be circumstances which justify the gas company in looking for substantial reductions in cost of production, and on the other hand gain of new custom as the result of the advertisement. But in any event, there is nothing alarming in this very localised "victory." What is quite certain is that electricity is steadily gaining support for street lighting purposes, both from those who have to pay rates and those who direct the spending thereof. Great as have been the improvements in the design of gas burners and lanterns, and in the matter of gas enrichment and its supply under pressure, even greater strides have been made in connection with electricity. The flame arc lamp is doing excellent service in many boroughs. Still more remarkable is the progress made with street lighting by means of grouped metallic filament glow lamps. For ordinary street service these answer admirably, giving a pleasant diffusion, and doing away with the strong contrast existing between light and shadow where powerful arc lamps are awkwardly placed. It is clear from reports which reach us week by week from

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KINGSWAY,
LONDON, W.C.

all over the country that this method of street lighting is constantly gaining in favour. We need scarcely wonder at this when we reflect on actual experience and study the pictures which we have published in these columns from time to time. Certainly electric light thus used provides efficient illumination, and from the economical point of view it is all that could be desired. Of course, there is need of considerable thought and the employment of art, both as regards the grouping and the choice of lanterns and reflectors. We have not reached the final word in this direction, though the advance hitherto made is decidedly satisfactory. It is interesting to find that in America the metallic filament glow lamp is even more largely used for public lighting than it is here, and that in spite of inferior civic engineering, leading to greater vibration, and the very trying ranges of temperatures. In this issue we publish reports of two valuable papers on tungsten lamp services in American cities, from which some useful data may be gathered.

JUBILEE OF THE TRAMWAYS.

It was on August 30, 1860, that the first tramway for public service was opened in England, namely, at Birkenhead, by George Francis Train, with whom Sir Clifton Robinson, then a boy of 12, was associated. As a matter of fact, the first introduction of the tramway was as early as the 17th century, when this novelty was laid down to facilitate colliery exploitation. But, although originating in England, it was left to the Americans to develop the system for ordinary passenger traffic. France was also before us in this direction, opening a horsed tramway between Paris and St. Cloud in 1856, but it did not invade Paris itself until 1875. Train was much struck with the utility of the system as carried out at Philadelphia, and came over to England to capture the land. Liverpool refused to listen to him, Birkenhead, thanks largely to John Laird, gave him an opportunity of testing his plans. In London Train laid tramways from the Marble Arch to Notting Hill Gate and in Westminster, but owing to the rail being of a sunken type—the "step rail"—inconvenience was caused, and the lines were ultimately pulled up. In the provinces the American promoter and his backers were more successful, the ventures in the "Potteries" and at Darlington proving remunerative. Primitive as these ventures were, they proved the forerunners of a vast and most useful revolution in traffic. We certainly have travelled far since 1860.

HOW ACCIDENTS HAPPEN.

A reader of ours sends us an amusing story about a church in a fashionable district of London. The edifice, it appears, was undergoing general repairs, and as a kind of after-thought an electrician was requested to inspect the electrical fittings. He did so, without meeting very much to alarm him, but when he came to the fuse box, he began to "get warm," as the children say. After fiddling about and gazing in a vacant kind of way, he turned to the ancient verger and demanded: "Who looks after the lamps and the electrical fittings generally?" With a rather nettled air, the old chap drew himself up and said: "I attend to *everything*." "Then, my friend," replied the electrician, no doubt thinking that even angels might tire of looking after that particular innocent, "never again replace burnt-out fuses with French nails." And we wonder how "mysterious" accidents happen?

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

CONTRACTS OPEN.

HOME.

BRAY.—The Urban Council invite tenders for the supply of 1,000 tons of best Welsh Through and Through steam coal. (Particulars, The Electrical Engineer). September 6.

LITTLEBOROUGH.—The District Council invite tenders for the supply and delivery of alternating current (single and three-phase) meters. (Particulars (42s.), from Messrs. Hawtayne & Zeden, 9, Queen-street-place, London, E.C.) September 13.

LONDON, FOR DURBAN.—The Town Council of Durban invite tenders for the supply of elevated jet condenser and piping, switchboard, rotary converters, cables and transformers. Particulars from Messrs. Webster, Steel & Company, 5, East India-avenue, E.C., to whom tenders must be sent by September 28.

PONTYPRIDD.—The Urban District invite tenders for the supply of low tension rubber insulated cables, with lead fireproof covering. (Specifications from the Electrical Engineer, Generating Station, Treforest, near Pontypridd.) September 5.

OVERSEAS.

CAIRO.—Public Works Department.—Electrical installations at Khanka Lunatic Asylum. (Particulars, Service Administratif Ministere des Travaux Publics.) October 20.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received, up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

CALCUTTA.—The Calcutta Electric Supply Corporation, Ltd., invite tenders for the supply, delivery and erection at their Cossipore station and sub-stations, Calcutta, of the following: Specification No. 5, motor generators; Specification No. 6, turbo alternators and condensing plant. Particulars from Francis R. Reeves, secretary, the Calcutta Electric Supply Corporation, Ltd., Salisbury House, London-wall, E.C. September 19.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. (Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels.) September 26.

HOBART.—The Deputy Postmaster-General will receive tenders up to noon on October 17, for the supply of various telegraph and telephone material (Schedules Nos. 1—9), including cable, instruments, switchboards, battery material, wire, insulators, ironwork, &c. A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). (Specifications, Direction des Chemins de Fer d'Outre-mer, Lisbon.) October 12.

LORENZO MARQUES.—Harbour and Railways Board.—One 10-ton and 75-ton electric cranes. (Particulars, 9 milreis gold, General Stores, Harbour and Railway Board, Lorenzo Marques, or Agency of Caminhos de Ferro de Lorenzo Marques, Johannesburg, or Direcçao dos Caminhos de Ferro Ultramarinos, Lisbon). English translation, 4·5 milreis gold, from Caixa Geral dos Depositos, Lisbon, or from the Johannesburg or Lorenzo Marques authorities above indicated. September 5.

MELBOURNE.—The Deputy Postmaster-General, Melbourne, will receive tenders on October 4 for the supply of telegraph and telephone insulators (Schedule No. 332). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, as above.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on October 4, for the supply of telephone material (Schedule No. 363). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. A copy of the specification may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

MOSTAR.—Municipality.—Electricity works. (Particulars from Chief Magistrate.) October 1.

SYDNEY.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to 2.30 p.m. on October 5, for the supply of 5,000 porcelain insulators. A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to each of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

TENDERS ACCEPTED.

HOME.

BATTERSEA.—The Borough Council have accepted Messrs. Pooley & Austin's tender for feeder switchboard.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given of tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ALTRINCHAM: T. Blagburn, architect, 20, Station-buildings, Altrincham. Additions to club.

BLACKBURN: F. J. Parkinson, architect, 9, Richmond-terrace, Blackburn. Elementary mixed school, Holy Trinity Church.

BOSTON: Scorer & Gamble, architects, Bank-street-chambers, Lincoln. Alterations to Territorial Barracks.

DUNDEE: The Dundee Industrial Schools Society have sold the premises in Park-place, used as a Boys' Home, to the St. Andrews Provincial Committee for the training of teachers, and have purchased new premises in South Ellen-street.

FOLKESTONE: A secondary school for 150 boys is to be built.

MERTHYR TYDFIL: Surveyor, Town Hall. Boys' and girls' schools, and domestic subject block.

MORECAMBE: H. Littler, county architect, 16, Ribblesdale-place, Preston. Art and Technical School.

POOLE: S. J. Newman, borough surveyor. Elementary School for 580.

PRESTON: Education Office, Preston. Grammar School for boys.

NOTES.

"Osrams" in a Synagogue.

The following extract from a recent issue of "The Jewish World" is of particular interest, even if only to show how far-reaching is the popularity of the metal filament lamp.

The Jewish fraternity are more than ordinarily conservative in regard to the introduction of modern ideas into their places of worship, but at Bradford, tempting claims of "Osrams" have apparently been the means of drawing them out of their usual stolid indifference to a march of progress in the outside world.

OSRAM·LAMPS

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PATENTS.

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AND
Certified Austrian Patent Attorney (Patentanwalt),
Specialist for German Patents and Patent Litigation.
55, CHANCERY LANE, LONDON, W.C.

THE PROPRIETOR OF THE PATENT NO. 16435 of 1905, for "Improvements Relating to Transmission Systems for Wireless Telegraphy and Telephony," is desirous of entering into arrangements by way of license and otherwise on reasonable terms, for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed, in the first instance, to—
HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
7 & 8, Southampton-buildings, Chancery-lane, London, W.C.

THE PROPRIETOR OF THE PATENT NO. 19979 of 1904 for "Improvements in Magnetic Wheels or Electro-magnetic Motors," is desirous of entering into arrangements by way of license and otherwise on reasonable terms, for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to—
HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
7 & 8, Southampton Buildings, Chancery-lane, London, W.C.

TO ELECTRIC LIGHT ENGINEERS.—The Owners of Patent No. 23,501[09], relating to "Improvements in Vacuum Tube Lighting," and Patent No. 12,582[02], relating to "An Improved System of Electric Lighting," desire to negotiate with Electric Light Engineers with the view of granting licenses under them on reasonable terms.—For information apply to MESSRS. LLOYD WISE & Co., Chartered Patent Agents and Consulting Engineers, 46, Lincoln's Inn Fields, London, W.C.

THE PROPRIETOR OF BRITISH PATENT No. 23172 of 1905, for "Improvements in or relating to Electro-Mechanical Systems for the Propulsion of Automobiles," is desirous of entering into arrangements with British manufacturers with a view to the granting of licences under the patent so far as the application of the system to traction on rails is concerned.
In this propulsion system a separate explosion motor and a dynamo, connected to a battery of accumulators, are provided for each driving wheel of the vehicle.
Interested parties are invited to communicate with the undersigned for further particulars.
HENRY SKERRETT,
Chartered Patent Agent,
24, Temple Row, Birmingham.

THE PROPRIETORS OF THE PATENT No. 4927, 1907 dated 1906, for "Improvements in or relating to Electric Furnaces," are desirous of entering into arrangements by way of license and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to:—
HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
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HAND LAMPS, Portable Electric, fitted removable Celluloid Accumulators, numerous types, for all purposes. Portable accumulators every description, hundreds of sizes. Catalogues free.—ARMSTRONG'S, Twickenham.

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MISCELLANEOUS.

CLEANERS and BLEACHERS of Meat Cloths for Engineers and Garage use, sold in 7 lbs. bundles at 3/6, cash with orders. Carriage forward.—A. & T. INGERSOLL, 62, Waterloo-street, Camberwell, London, S.E.

EVERY ARC LAMP USER in the kingdom should read "The Application of Arc Lamps to Practical Purposes," by Justus Eck, M.I.E.E. The best book on the subject ever issued. Clearly written and well illustrated. Practically it is the "Arc Lamp Users' Manual." Cloth 8vo. 2s. 9d. net, post free, from RENTELL, Publishers, London.

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FIRST-CLASS WIREMAN requires situation; used to all kinds of work.—Box B., c/o THE ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

APPRENTICE-YOUTH, seeks apprenticeship with Electrical Engineer. Intelligent, good education.—S.A., c/o ELECTRICAL ENGINEER, 149, Fleet-street, E.C.

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HULL.

This is, we believe, the first instance in the country of a Synagogue being illuminated by metal filament lamps.

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By referring to our illustration, giving sections of the working parts, it will be seen that the construction has been greatly simplified, which makes repair a matter of ease.

With this type of construction it is no longer necessary to scrap otherwise good meters because some essential part has deteriorated; further, the high cost of repairs is saved as well as the loss of time and use of the meter when under repair. Under these conditions it will be seen that the meter is particularly suitable for export work, and it is not astonishing to hear that it has been very favourably received abroad on account of its special features.

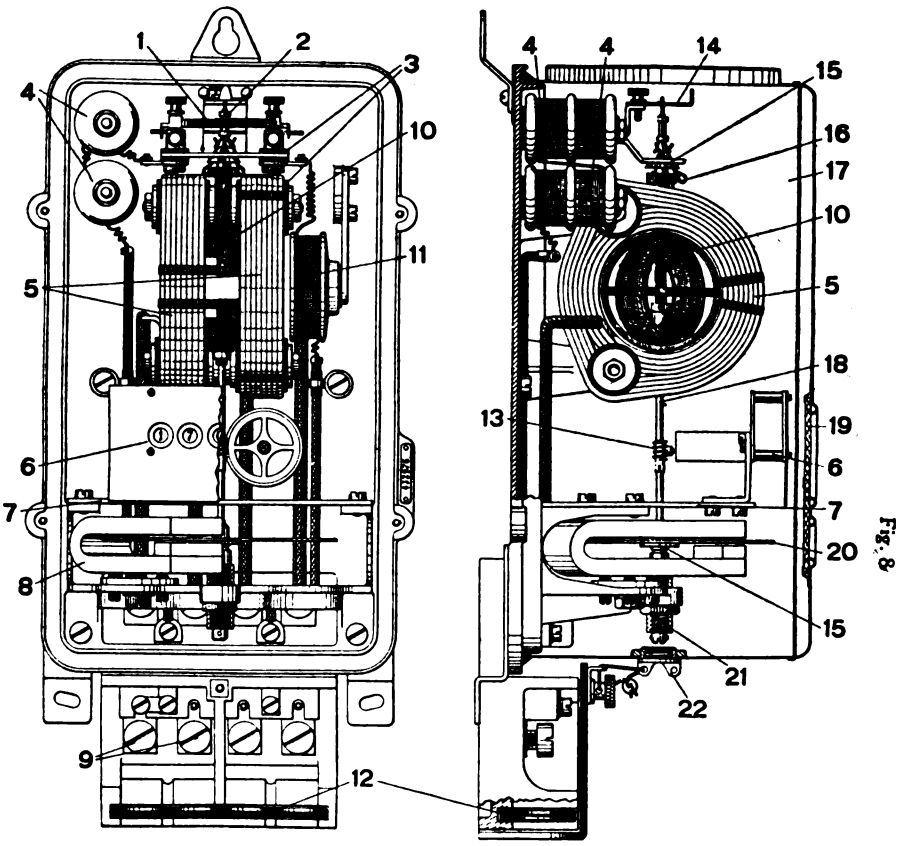

Fig. 8.

Siemens Watthour Meters.

Messrs. Siemens Bros. Dynamo Works have brought out a novelty, in the form of the G4 type Watthour meter, which marks a step forward in meter construction, as all the working parts can be replaced without tools, and the replacement of any or all parts does not necessitate recalibration. The deterioration in accuracy of the meter can usually be traced to the wearing of commutator, brushes, bottom pivot or jewel, these being the parts exposed to wear and tear. The original accuracy of the meter is restored, on the worn part being renewed.

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3. Insulation.
4. Resistances.
5. Main Series Current Coils.
6. Counter.
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11. Compensation Coil.
12. Terminal Insulating Bushes.
13. Worm.
14. Top Pivot.
15. Clamping Stop.
16. Commutator Contact Spring.
17. Cover.
18. Armature Spindle.
19. Glass Window.
20. Brake Disc.
21. Combined Bottom Pivot, Jewel and Stop Screw.
22. Screw Hole and Stopper giving access to Stop Screw.

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TECHNICAL CLASSES.

City and Guilds of London Institute.

ENGINEERING AND CHEMISTRY.

There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

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(EXHIBITION ROAD, S.W.)

A College for Higher Technical Instruction for Day Students not under 16 preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a "*School of the University of London*," and also forms the *Engineering Section of the Imperial College of Science and Technology*. The Entrance Examination includes the subjects of Mathematics, Mechanical Drawing, Physics, Chemistry, English Composition, and French or German Translation, and the Courses of Study for the Associateship of the Institute cover a period of three years. Fees, £36 per Session. Professors :—

Civil and Mechanical Engineering .. W. E. DALBY, M.A., B Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering .. .. T. MATHER, Wh. Sch., F.R.S.
Chemistry .. .. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics .. O. HENRICI, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY.

(LEONARD STREET, CITY ROAD, E.C.)

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Physics and Electrical Engineering .. .. SILVANUS P. THOMPSON, D Sc. F.R.S., Prin. of the College
Mechanical Engineering and Mathematics .. E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry .. .. R. MELDOLA, F.R.S., F.I C.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C.

Northampton Polytechnic Institute,

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ENGINEERING AND TECHNICAL OPTICS.

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The Session 1910-11 begins on Monday, October 3rd.

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Intending Students should communicate with the Provost as soon as possible, and in any case not later than SEPTEMBER 20th, and should send a full statement of their previous training.

Full particulars may be obtained on application to the undersigned.

WALTER W. SETON, M.A., *Secretary*,
University College, London
(Gower Street).

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SESSION 1910-11.

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The preliminary examination for Candidates for the Diploma begins on September 19. Names of Candidates must be lodged not later than September 1.

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Armstrong College, Newcastle-upon-Tyne.

PRINCIPAL: W. H. HADOW, M.A., D.MUS.

SESSION 1910-11.
(*Commencing September 26th*, 1910).
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TECHNICAL CLASSES—continued.

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PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

THE "BUTT" ARC LAMP.

Novel Features.

In the "Butt" arc lamp, the General Electric Company have achieved a remarkable advance. It has been standardised to the highest degree, it being adapted for use on the direct, alternating and rectified circuits, while its working parts have been simplified in a notable manner. It is self-regulating, without clockwork or regulation coils. Ordinary cylindrical metal cored flame or pure carbons are used, not the "ribbed" variety. In Fig. 1 we see the vertical carbon clutched in the centre of the lamp, while the sticking carbon on the right is influenced by the square pulling magnet above, through which can be moved laterally to strike and form the arc. By keeping the carbons continually in the same position without horizontal movement after the arc is struck, the arc chamber is sealed

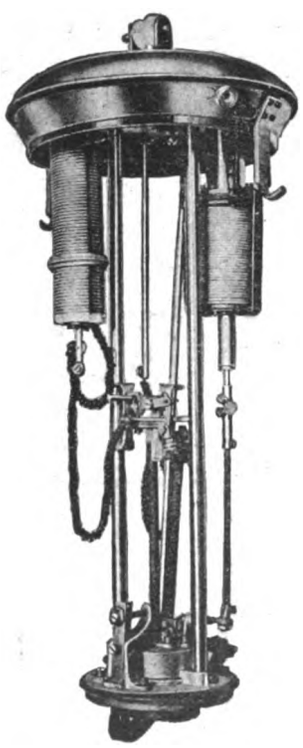

FIG. 1.—INTERIOR MECHANISM.

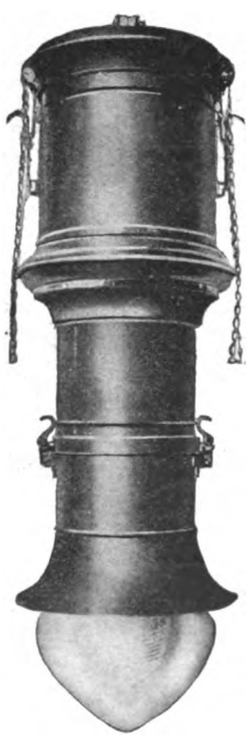

FIG. 2.—LONG HOUR TYPE. BURNING 16-18 HOURS.

against the rod chamber, thus the guide rods are kept free from deposit. The clutched central carbon controls the feed, resting on the lower arm of the clutch lever shown below the lamp plate in the economiser. This lever being pivoted presses with its small upper arm through the plate against the carbon. While any weight bears on this incombustible arm, the lever grips the carbon sideways, easing the fine carbon point. As consumption progresses and the carbon becomes shorter, the pressure of the point on the lower lever arm decreases, which in turn reduces the side pressure of the upper arm against the carbon, until the weight overcomes the break action and the carbon can slide down. It will be seen that this overcomes the danger of breaking the point, which becomes longer and longer, so raising the arc away from the lever arm, which is thus protected from burning. When the carbon is reduced to a stump, the clutch automatically discharges it, thus interrupting the current. The case, owing to the simplicity of the mechanism, is shorter and less clumsy looking than in the ordinary run of arc lamp; it is strongly made, well ventilated, and affords good protection against damp and wind. The lamps are fitted with an inner conical globe, which prevents the outer globe from becoming dirty and protects the inner lamp from temperature variations. The result of all this is that the General Electric Company have placed on the

FIG. 3.—SHORT HOUR TYPE. BURNING 8-10 HOURS.

market a low priced, highly efficient arc lamp, adaptable for any kind of service, and most economical as regards working and upkeep. There is practically nothing to get out of order, while all vulnerable parts are well protected.

Another noteworthy success is the design of the double carbon "Butt" lamp, which will burn from 32 to 38 hours, thus reducing the cost of maintenance. These are on the same principle as the lamp first described, being self-regulating and minus all clockwork or shunt coils. These long hour lamps are used mostly for out-of-door illumination, and are provided with a dioptric inner globe in order to increase the lateral spread of illumination.

It is claimed that the yield of light is 1 c.p. per 0·13 watt. There is evidently a big future before a lamp of so low a first cost, adaptability of application, saving of maintenance, and high efficiency.

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FIG. 1.—VIEW SHOWING A PORTION OF THE INTERIOR OF THE CITY EXHIBITION HALL.

A BUSINESS SHOW.

The Engineering and Machinery Exhibition, Manchester.

Manchester is so much the centre of the British machinery world that it is a fitting place for a thoroughly business show to be held. Proof of this is afforded by the success already assured to the Engineering and Machinery Exhibition to be held in the City Exhibition Hall, Liverpool-road, Deansgate, from October 14 to November 5. It is promoted under auspices to inspire confidence in the mechanical and business world, for the responsible organisers are the proprietors of our enterprising contemporary, "The Engineering Review." It is now some months ago that they took up the idea, and calling together representative men in every branch of engineering industry, proposed the holding of a big business show. The response was all that could be desired, and it was soon seen that enough support was forthcoming to justify the scheme being carried forward. Mr. Charles H. Luke, A.M.S.E., the Exhibition Director, and his colleagues soon produced a convincing programme, and succeeded in retaining the services of Mr. Walter Cawood as manager.

Space has been letting well, and we mean by that, not only has a large percentage of the available area already been booked, but that such booking has been done by leading firms in different branches of engineering. Thus a really comprehensive show is assured, and by firms whose reputations make it incumbent that only the best of everything shall be brought forward. Consequently, the Hall will be well worth visiting. As to that, however, assurance is being made doubly sure, by the promotors undertaking to distribute admittance cards to 20,000 selected buyers. Wisely, it has been decided that the price of admittance will not be reduced during the evenings, but on the other hand, special terms are being granted where parties from engineering works, from technical schools, or from societies propose to visit the Hall.

Much is being done to facilitate the work of exhibitors. For instance, an experienced cartage contractor has been appointed, who will transport goods to and from the station and hall at the rate of 3s. per ton each way; while in the Hall a 10-ton traction crane is being provided. Electric power is to be supplied at the net rate charged by the Manchester Corporation, which will not exceed 1¼d. per unit, the voltage for 3 h.p. and over being 400. For lighting purposes, electricity at 200 volts will be supplied at Corporation rates, or the promotors will provide 16 c.p. lamps and current for the whole period of the Exhibition at 10s. 6d. per lamp. Arrangements are also being made so that exhibitors may have the telephone on their individual stands. Gas and water will, of course, also be provided, the idea being to show as much machinery at work as possible.

Apart from individual lighting of stands, the illumination of the Hall as a whole is excellent. Our illustration gives some idea both of the dimensions and the suitability of the Hall for an Exhibition of this kind. Our plan serves as a completent, showing exactly the position of the Hall in its relation to the main streets. It only remains for us to say that the charge for space in the Hall has been fixed at 4s. (and under the gallery at 3s.) per square ft. Large as the Hall is, a considerable portion of it has already been taken up, so it behoves would-be exhibitors to apply for particulars to the Exhibition Offices, at 16, John Dalton-street, Manchester, or at "The Engineering Review," 104, High Holborn, without delay. Practically all the available space has been booked.

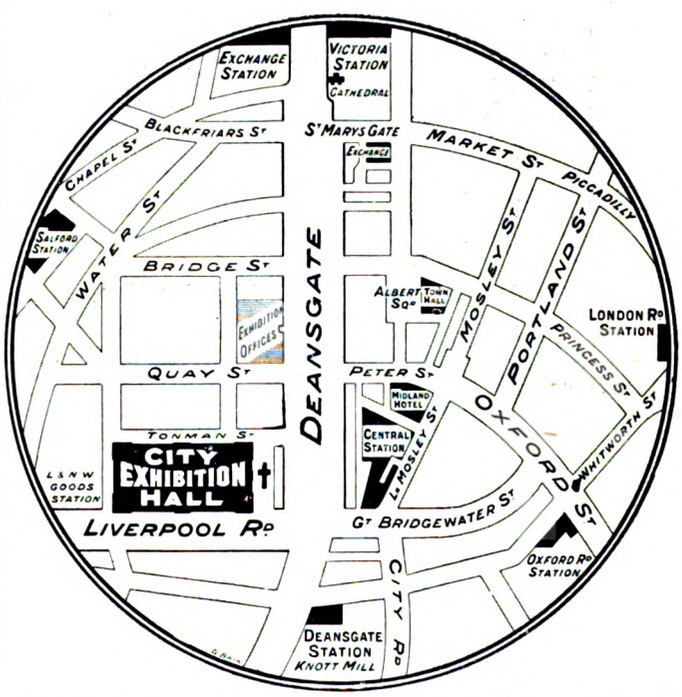

FIG. 2.—PLAN SHOWING POSITION OF THE CITY EXHIBITION HALL.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

The Tyneside and Wearside area has always been closely associated with the course of technical education, and as this is allied with the best interests of electrical engineering it may be well to refer to one or two recent developments. In the first place, i has now been decided after considerable discussion by the Sunderland Education Committee to erect a new college in a convenient situation within the borough, which will have some effect in rendering it less necessary for students in that area to take the railway journey to Newcastle. This step is subject to the final approval of the Corporation. Another interesting feature, recently announced, is the decision on the part of the Newcastle-on-Tyne Association of Students of the Institution of Civil Engineers to inaugurate a course of evening classes at the Armstrong College for local engineers who desire to sit for the Associate Membership examinations of the Institution. The course includes the theory of structures, hydraulics, theory of heat engines, strength and elasticity of materials, and electricity and magnetism. The two latter have a laboratory course. In addition geodesy, including a field course, is to be dealt with. The development is under the superintendence of Principal Hadow, and the session is to extend from October to March. The local association of students has also made arrangements to foster *esprit de corps* by opening a club-room at the Bolbec Hall, in Westgate-road, Newcastle-on-Tyne, on certain evenings of the week.

The Development of Blyth.

Reference has already been made in this column to the rapid developments which are taking place at Blyth. By the provision of additional wharves and staithes it is intended to proceed at once with the enlargement of the facilities of the port for coaling to an ultimate extent of about six million tons of coal per year, while provision is being made for the better accommodation of the fishing fleet. In connection with the very considerable increase in the use of electric power at this port, together with the adoption of electricity by collieries in the area surrounding Blyth, the Newcastle-upon-Tyne Electric Supply Company, Ltd., have recently installed a large sub-station with a capacity of over 4,000 h.p., which will be supplied with energy from Carville power station through the 20,000 volt northern trunk main, the progress in the construction of which has been noted previously in this column. The size of the sub-station is 47 ft. in length and 22 ft. in width, and will contain five transformer chambers. The work, so far as the transformers and high tension gear are concerned, will be carried out by The Electric Company of London, while Messrs. A. Reyrolle & Company, Ltd., of Hebburn, will supply the low tension gear.

The Consett Company's Oil Engine Fire.

With further reference to my notes last week on the unfortunate fire which occurred owing to the ignition of oil in connection with an oil engine in a colliery, it now transpires that unless another pump could be placed in commission there was some danger of the flooding of the workings. Fortunately there was the electric main transmission system of the Cleveland and Durham Electric Power, Ltd., about half a mile from the pit-head, so that a step-down transformer was installed and cable run to a 60 B.H.P. motor and pump placed inbye. This plant was able to cope with the incoming water before it had gained to any serious extent. The existence of the electric mains within the area of the County of Durham thus proves its value, and owners of collieries who rely on private plants may well take a hint from the occurrence as to the risk run by not taking supply from a public source when this is available.

Seaham Harbour.

Another of the rapidly-growing ports on the North-East Coast which well repays attention is Seaham Harbour, where it is proposed to extend the shipping berths at the docks in time to get them into operation within the year. This port is the outlet for several important collieries, notably Dawdon Corriery and the developing Easington Colliery. In connection with the latter pit it has now been decided to take electric power from the County of Durham Electrical Power Distribution Company, Ltd., which company is building a two-storey sub-station of 1,500 h.p. capacity to supply the Easington pit and village.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

Electrical manufacturing firms in the Midlands are nearly all busy just now. The season is one in which it is not usual to expect any special developments, but the work in hand is sufficient to keep all the principal firms well occupied pending the coming in of the autumn business. The general state of trade is regarded as likely to result in a considerable increase of electrical work, inasmuch as many manufacturers desirous of adopting electrical motive power have been postponing the conversion until the hoped-for better times. Though no contracts of any great magnitude are reported this week, there is a general increase of work both for lighting and for power, the latter principally for small manufacturers. Enquiries with regard to electrical rolling plants continue to be made from many quarters.

Telephone Extensions.

The National Telephone Company continues to extend its operations in this district. During the past few months, the provision of four important sub-exchanges has been undertaken. Two of these exchanges are already in operation, namely, the "Edgbaston," with provision for 1,000 subscribers; and the "Victoria" for 420 subscribers, both worked on the common battery principle. In each of these cases the company erected a special building, provision being made in accordance with the company's practice for future extensions. The architects were Messrs. Bromley & Watkins, of Nottingham, while the builders of the Edgbaston exchange, which is situated in Belliss-street, Ladywood, were Messrs. John Barnsley & Sons, and of the Victoria Exchange, which is in Sandy-lane, Bordesley, Messrs. Dickinson, of Derby. The other two new exchanges will be opened some time in October. One of these is at the corner of Beale-street and Alfred-street, Aston Manor, and will be known as "East," replacing the temporary exchange of that name. The architects are Messrs. Bromley & Watkins, and the builders are Messrs. William Lee & Son, of Aston. It is a three-storey building, handsomely fitted up, having terrazo floors on the landings, and the designs, in view of the approaching transfer, have been approved by the Post Office. Provision will be made for 580 subscribers, the plant comprising four junction positions, a number-10 type common battery switchboard, 100 outgoing junctions, 92 incoming junctions, one motor generator, and two ringing generators. The fourth of these sub-exchanges, which will be known as the "Northern," and will also replace a temporary exchange, adjoins the Villa-road Post Office, Handsworth. The premises have been rented from the Post Office, but the exchange will be quite independently worked by the company up to the date of the transfer. Provision is made for 690 subscribers, there being installed two junction positions, a No. 1 type common battery switchboard, 60 outgoing junctions, and 54 incoming junctions. The batteries will be supplied by two

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motor generators, and there will be two ringing generators. The generators in all these cases are by the Western Electric Company, and are of a type specially designed for the telephone service. The new exchanges will contain accommodation for callers. The exchanges of the National Telephone Company in Birmingham, 26 in number, have in all between 10,000 and 11,000 lines. At the "Central" Exchange, in Newhall-street, which was the first of the larger exchanges to be erected, there are nearly 6,000 lines, between 2,000 and 3,000 being on common battery switchboard, and about 3,000 on the older magneto system. At the newer "Midland" Exchange, in Hill-street, there are about 1,600 lines, and this exchange is entirely on the common battery system. The building in Hill-street is one of the largest and finest of its kind, and arrangement of the buildings, as well as the site acquired, makes ample provision for extension.

Territorial Engineers.

The Birmingham electricians forming the local engineer units of the Southern Army, under the command of Lieut.-Col. J. F. Lister, R.E. (T), organised recently in conjunction with the 3rd South Midland Brigade Royal Field Artillery, an interesting military tournament on the Tally Ho! Ground at Edgbaston, and though the weather early in the afternoon was such as to effect the attendance adversely, the demonstrations themselves proved a great success. The Muirhead wireless equipment, with which Captain Matthew's men did such excellent work at Windmill-hill during the recent manœuvres, was exhibited at work, being kept in communication with a station at the headquarters of the corps, Great Brook-street Barracks. Here a Post Office telegraphist received the messages and despatched them. Among the senders was Mr. Neville Chamberlain, whose message was addressed to his father, the Right Hon. Joseph Chamberlain. At the close of the tournament, Mr. Neville Chamberlain distributed the prizes. The band of the Telegraph Engineers performed on the grounds. It is expected that members of the Air-Line Company will take part in the Army Manœuvres in September.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

Whilst the gas works are talking of ceasing payments in relief of rates and reducing the capital charges on their plants with a view to better meeting the competition of electricity, the electrical undertakings are all telling the same tale of increased loads, and planning extensions to their plants to meet them.

At Stockport the Borough Electrical Engineer, Mr. Lomax, has been entirely remodelling the generating station, and most of the cost has been met out of revenue—a very healthy sign. The old bi-polar generators and engines have been replaced by five 500 kw. traction generators of Dick Kerr's, and the Lancashire Dynamo and Motor Company's makes with Bellis and Morcom engines. New switchboards have also, of course, been put in. New coal bunkers and conveying plant, supplied by Benins, Ltd., and erected by the station staff are other improvements; the bunkers are of reinforced brickwork. Considerable extensions in mains are being made and a Lancashire Dynamo and Motor Company's booster has been put in. The Tudor battery, which originally had a discharge rate of 1,065 amps. for one hour, is now being replated to give 1,885 amps. Superheaters will probably be added to the Lancashire boilers later on. A contract has just been let to build a retaining wall and pump-house on the bank of the Mersey, just behind the power-house. This will protect the foundations and add a little land; the cost will be about £3,240.

Power Load Development.

The power load for the June quarter showed an increase of 34% over the corresponding quarter of last year. In Stockport there are many trades using power, but that making and textile work are probably the two chief. One hat factory takes nearly 300 h.p., another has 100 h.p., and is arranging for 60 h.p. more. Textiles are also fairly represented. At present a large doubling mill is negotiating for about 600 h.p., and other mills will probably come on later. Eighteen months ago substantial reductions in the price per unit were made, and power is now sold as follows:—First 50 units consumed per h.p. of motor installed, per quarter, 1·25d.; for the second 50 units on the same basis, 1·125d.; for the third, ·875d.; and for the fourth and all in excess, ·75d. These prices are very reasonable, but for large consumers the price is better still. Large consumers with constant work and willing to guarantee a consumption of not less than £80 per annum are supplied at the following rates:—First 50,000 units per annum, ·75d.; second 50,000 units, ·7d.; and consumers of 100,000 units per annum, ·6d., with a rebate or addition of 2s. 6d. per 1,000 units for every 1s. per ton variation in the price of coal based at 10s. per ton. These consumers have their accounts rendered monthly.

There is also a hiring and hire-purchase department for motors. The hire-purchase terms are one-fifth of the cost of motor, etc., paid down, and the remainder in sixteen equal quarterly payments. The motors are fixed free on consumer's foundations and periodically inspected and kept in condition by the department until the payments are completed, when the consumer takes full charge of them.

The extensions to plant just completed are expected to just get through the winter, but the question of further extensions for next year's load is being considered, though nothing has been settled. It is not unlikely, however, that the new extensions (which will not necessitate any new buildings) will be D.C. plant, and possibly with exhaust turbines. At the very low rates for power, the Stockport station should quickly double its present capacity.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The Allgemeine Elektricitats Gesellschaft has just published a beautifully illustrated prospectus of the plant supplied by them for electrically driving rolling mills in iron works, and also an interesting pamphlet on electric wires insulated by coating them with enamel, a process which is of the highest interest in technical electricity.

German Electrical Undertakings.

Now that nearly all the reports for 1909 are in, it is possible to take a general view of the present condition of the electrotechnical industry in this country. On the whole, this condition was better in 1909 than in 1908. Dividends have increased, although it is not always the case that increased profits mean a better business position. In the first seven months of the present year 39 balance sheets have been issued, concerned with a capital of 331 million marks, an increase of 20 millions. Thirty-three undertakings made for 1909–10 a net profit of 42 millions on a capital of 324 millions, as against 38·8 millions on a capital of 306 millions in 1908–9. Four concerns had a loss totalling 890,686 marks, as against 377,629 in 1908–9; 36 undertakings paid for 1908–9 26 millions in dividends on a capital of 309 millions, and for 1909–10 28½ millions on 327·8 millions, the average rate thus being only slighter greater—8·7% instead of 8·4%. The chief rises in dividend were with concerns having capitals of from five to ten millions. In one case the dividend rose from zero to 3%, and in another from 4% to 10%. The next best results are shown with capitals under one million. The largest concerns showed no appreciable change in dividend, taken collectively, for while the Siemens & Halske A.G., dividend rose from 11 to 12%, and that of the Nurnberg Schuckert Werke from 5 to 6%, the Felten und Guilleaume Lahmeyer distribution fell from 8% to 6%, and that of the Elektrizitatswerke vorm Lahmeyer, of Frankfurt, from 6 to 5%.

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New Wireless Station at Pola.

The tower of this station is built after the pattern of that at Nauen, and is as high as the Eiffel Tower, and the conical collection of antennæ surrounding it communicate underground with a wire netting covering about 40,000 square metres (10 acres), so that perfect earthing is certain. The iron tower is insulated by massive columns of glass supported in their turn by marble masonry. The sparking can be heard at 40 paces from the base of the tower, and the sparks are 20 to 24 inches long. The singing spark system of the Deutsche Gesellschaft fur drahtlose Telegraphie is the one adopted. The transmission tension is from 140,000 to 150,000 volts. The field of action extends through Sansego, Antivari, Corfu, Brindisi, Rome, Malta, Toulon, Paris, Berlin, Nauen and Norddeich, and has a radius of about 700 miles normally, but under favourable conditions messages have been exchanged with the great Marconi station at Poldher, which is at a distance of 900 miles. Pola is the Austrian Portsmouth.

Electric Trams in Saxony.

The length of these tram lines was over 200 miles at the end of 1909. Nearly half of this length, was in Dresden, while Leipzig was responsible for 72 miles. The number of passenger journeys made in the year was 241 millions, 101 millions in Dresden, 104½ millions in Leipzig, and 23½ millions in Chemnitz; 281 cases of personal injury occurred in the year, 159 in Dresden and 95 in Leipzig. There were 18 fatal cases, 6 in Dresden, 10 in Leipzig, and 2 in Chemnitz.

Company Affairs.

The mining authorities of Saarbrucken have just concluded a contract with the A.E.G., in virtue of which the A.E.G. will undertake the management of the current supply from the Saarbrucken stations to a large part of the south-west of the Rhine Province and neighbouring territories. The A.E.G. is to institute a special company at Saarbrucken which is to lay down mains as soon as possible. It is hoped that the result of this arrangement will be a cheap supply of current for light and power purposes over a radius of 60 miles round Saarbrucken. The price charged will be according to the amount of current used, from 6 to 14 pfennig per kilowatt hour, and discounts from these prices will be allowed under certain conditions. As regards householders, it is contemplated to charge 40 pfennig per kilowatt hour for lighting rooms. Towns will be charged 30 pfennig per kilowatt hour for street lighting, and 20 pfennig per kilowatt hour will be charged for power current.

The Bank fur Elektrische Unternehmungen, Zurich, reports good business for 1909–10. The net profit was 4,381,341 francs. Of this, four millions will be devoted to paying a 10% dividend on the share capital, but the directors' share has been cut down from 195,297 francs in 1908–9, to 194,808 francs only.

The Rheinisch-Westfälisches Elektrizitatswerk at Essen is paying an 8% dividend for 1909–10 on its capital of 30 million marks, to which, however, another 8 millions will shortly be added. When the company was first started in 1898 its capital was 2½ million marks only. This will show what can be done in Germany.

The Strassburg tramways carried 26½ million passengers in 1909–10, as against 25½ millions in 1908–9. The net profit rose from 248,934 to 327,904 marks, the takings from 835,663 to 1,004,694 marks. The dividend will, however, remain at 6%, as it has been thought desirable to increase some of the reserves; 12,121 marks (12,248 in the previous year) will be carried over.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

On a large nursery, run by Brown Bros., at Rochester, New York State, there is a three-and-a-half ton electric truck in daily use. During the shipping season it is used to take trees and shrubs to the depôt, and bring back fertilisers and farm stores. In the harvest season it is run into the fields and is loaded up with hay or wheat, a the case may be. It will take 617 bundles as against 260 by a pair-horse wagon. The truck is the standard type of the General Vehicle Company, and was sold through the Rochester Railway and Light Company, who, of course, supply the power.

Flaming Arc Lamps for Contractors.

Contractors are now using flaming arc lamps for all kinds of excavation works, such as trenching and tunnelling, and also for street railway building and street paving. The Hawthorn flaming arc of the Western Electric Company appears to be a favourite for this purpose, and has lately been used to good purpose at Brooklyn in excavating a subway extension. It is claimed that a Hawthorn will give 3,000 c.p. at the same cost as 300 c.p. by an ordinary arc lamp.

Storage Battery for Ships' Lights.

The *Alabama* s.s., plying between Chicago and Maskegon, has been fitted up with a complete stand-by equipment of electric lights, supplied with current from a storage battery of the Chloride Accumulator type. It has a rating output of 4·5 amp. for 8 hours, and will supply current for 10 hours on one charge for 25 four c.p. 100-volt carbon lamps. The primary idea is that this installation should be available in the event of an accident to the electric generating apparatus.

Westinghouse's Latest.

The latest move of the Westinghouse Electric and Manufacturing Company is the acquisition of a controlling interest in the Interworks Railroad, a concern which runs from East Pittsburg to Trafford City, through Turtle Creek, Wilmerding and Pitcairn, a distance of seven miles.

Water Power in New York State.

An important survey has been completed by the New York State Water Supply Commission, for the provision of a storage reservoir in the Black River at Hawkinsville, a village in Oneida County. This village will be completely wiped out by the reservoir. It is proposed to construct a dam 130 ft. high and 1,500 ft. long with foundations upon the solid limestone which underlies the site. The type selected is an earthen embankment with a masonry spillway. The survey shows that such a dam would impound nearly 6,000,000,000 cubic ft. of water, creating a lake five and one-half miles long and two miles wide at its widest point, and extending from Forestport to a point a mile below Hawkinsville. The purpose of the reservoir is to regulate the flow of the Black River, and studies by the engineers show that in so doing it would be possible to utilise this flow continuously to produce 11,220 h.p.

Electrical Exports.

The official returns of exports for the year ending June 30 shows that the electrical trade has advanced. The total exports are valued at 14,752,395 dollars, which is an advance of 2,218,004 dollars on 1908–9, though it is still over half a million dollars below 1907–8, and over two-and-a-half millions below the high water mark of 1906–7. The falling off is chiefly in the matter of machinery. Appliances, including telephone and telegraph instruments, amounted last year to 8,694, 132 dollars, the biggest total reached so far in this class.

Rating Machinery.

At the Ohio Electric Light Association's Convention, referred to in my notes last week, Mr. R. J. Feathers, of the Columbus Railway and Light Company, read a paper on the "Best Methods to be Followed in the Purchase of Station Apparatus," which is likely to lead to practical results. Mr. Feathers, in speaking about cost, points out that it might be that a relatively cheaper, in first cost, machine may be much the more expensive when operating costs are considered; to this end it is important that the

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apparatus be highly efficient, also capable of withstanding overload for a reasonable period, have in direct current machines excellent commutation preferably equipped with commutating poles which will permit for a short period the overloading of such machines to a point far in excess of that which would be practicable with the older type of machines having a neutral point that shifts and causes sparking at the brushes with every change of load. The feature of excellent commutation is important as a machine which sparks and burns and which needs sanding and stoning frequently, or on which the commutator may require turning often, as this is a source of expense in maintenance; it is well to remember that commutator copper is expensive, and that the labour required to keep continually nursing the commutator of a machine amounts, in a year, to quite a sum of money, to say nothing of the trouble and inconvenience caused by poor commutation. A machine of low rotative speed is to be preferred ordinarily on account of there naturally being less wear, and also will probably be a more quiet running machine.

For Intermittent Use.

Mr. Feathers went on to say that in case of purchase for intermittent or occasional service, such as auxiliary for water power plant, probably a machine having a comparatively high rotative speed would be the more economical, as the first cost would ordinarily be less and the upkeep in brushes and attention required be very slight on account of the small number of hours run. In an auxiliary plant of this character the money invested should be as small as possible as in the running of a plant for, say, two or three weeks per year, the relative saving due to the higher efficiency of more expensive apparatus and the money which would be wasted in loss of interest and depreciation on a more efficient plant could probably be as well spent for a little more coal and attention, as the losses due to the cheaper apparatus would only exist for a short portion of the time, while interest and depreciation charges are continuous. On the other hand, with a plant which is expected to be in continuous operation, the operating costs may with profit be lessened by more efficient and more expensive apparatus. In the case of a machine which is expected to be operated continuously, the efficiency and low cost of operation are factors to be carefully considered, as a cheap, inefficient machine may during its life waste more than its original cost by high cost of operation. After a decision has been reached as to what is required in capacity and what character of machinery is desirable, also what steam pressure will be available, in case the equipment to be purchased is an addition to an already existing plant, a request for complete data and specifications should be made to the manufacturers, requiring them to be especially explicit as regards steam consumption and capacity for overload for a reasonable length of time, stating that these features are to be given due consideration when deciding on the purchase.

Data on Motors for Power.

In the discussion which followed, Mr. Gillmartin spoke about the difficulty of comparing estimates owing to the different ratings given a machine at different capacities and different temperatures. He thought some of the trouble might have been avoided if the invitation for tenders had been more carefully worded, so as to include the limitations that the purchaser wanted. Thereupon, Mr. Beckstein suggested the appointment of a committee on motor applications, to gather all data on power business and to publish the information in pamphlet form. This proposal was carried into effect, a committee being instituted for the purpose.

FINANCIAL NOTES.

SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER COMPANY, LTD.—Warrants for dividends on the company's 7% cumulative first preference and 6% cumulative second preference shares, for the half-year ended June 30, 1910, have been posted.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS.

A meeting convened by the Association of Mining Electrical Engineers is to be held at the Beaconsfield Room, Grosvenor Restaurant, Glasgow, on Saturday, September 17. To this meeting all managers, under-managers, electrical engineers and engineers of collieries in Scotland have been invited, the object being to form a branch, or branches, of the Association in Scotland. To promote this movement, Mr. J. Glynn Williams is visiting the Scottish coalfield, and will hold informal preliminary meetings at the Victoria Hotel, West George-street, Glasgow, on September 3; at the Royal Hotel, Dunfermline, on September 5; and at Milnes Hotel, Leith-street, Edinburgh, on September 6. There should be a good response to this appeal, for the Association is making remarkable headway in England and Wales.

ELECTRIFIED CROPS.

We have mentioned from time to time the experiments carried on both at home and abroad to test the influence of electricity on germinating seeds and growing crops. The subject has been brought a step forward by the lecture of Mr. J. T. Priestley, of the University of Bristol, before the Royal Horticultural Society. Mr. Priestley's object was to report progress as to experiments carried on in co-operation with Professor Newman at the farm of Mr. Bamford, Evesham.

The method described by Mr. Priestley consists of the conveyance and dispersion of a high voltage electric current over growing produce both outdoors and in greenhouses. The apparatus is so constructed as to send showers of electric sprays over a portion of a growing wheat field, a vegetable garden, and a conservatory 100 ft. in length, constructed for the cultivation of cucumbers. The results have been satisfactory, and in some respects surprising. Carefully tabulated, they showed in respect to the outdoor experiments that wheat gained 29% in the process, mangolds 18%, and strawberries 25%.

To illustrate the acceleration of growth under the treatment some striking lantern slides were exhibited. In one a boy was shown standing in front of a hawthorn hedge which had been untouched by the electric sprays. The tips of the branches just reached the boy's shoulder. The next picture showed the same boy and the same hedge after two weeks of electric treatment, when the branches were two or three feet above the boy's head. The results in the conservatory were quite as remarkable.

Mr. Priestley claimed, as the outcome of his experiments, two definitely ascertained facts—that the growth of the plants is accelerated, and that the plants become strengthened and more able to resist disease. In reply to a question by one of the audience, Mr. Priestley said the keeping qualities of the electrically grown plants were now under observation. So far as he had been able to determine, the wheat kept longer, but mangolds did not keep so well. The strawberries were not so large as those untreated, but they were sweeter and of richer flavour.

PUBLICATIONS.

"Journal of the Institution of Electrical Engineers," No. 203, August.

This number contains five papers read before the Institution, with discussions, and one original communication.

"Practical Measurements." By A. W. Siddens and A. Vassall. Cambridge University Press. Price 1s. 6d.

A book for students, designed to bring mathematical and science teaching into closer relationship.

"The Textile Institute Journal." Vol. 1, No. 1.

Contains historical note and report of the Inaugural Meeting and Dinner of the Institute.

"Electricity in the Service of Man." By R. Mullineux Walmsley. Cassell & Co. Price 6d.

The tenth monthly part of this revised and enlarged issue is now out. It is evident that the author has been at considerable pains to bring the work up to date. It is remarkably well illustrated.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ADWICK-LE-STREET.—A Local Government Board Inquiry has been held by Mr. H. A. Reed, M.Inst.C.E., into an application by the Doncaster Rural District Council for sanction to a scheme of main sewerage and sewage disposal for Adwick-le-Street and property near the station, which also includes the disposal of property at Woodlands Model Village and the village now in course of erection at Scunthorpe. It is proposed to convey the sewage for a portion of the district to an underground pumping station where storage tanks will be provided and the sewage pumped to the Woodlands Sewage Disposal Works automatically by electric motors driving centrifugal pumps. The other portions will gravitate to the works. The sewage after passing through screening and detritus tanks will be dealt with in liquefying tanks, followed by double filtration through continuous filters, the final effluent discharging into humus tanks and thence into the Mill Dyke. The population to be dealt with at the works will be about 12,000. The scheme has been designed by Messrs. D. Balfour & Son, of London and Newcastle-on-Tyne.

BARNSTAPLE.—The Town Council are applying for powers to borrow £1,970, partly to cover an overdraft and partly for extension purposes.

BELFAST.—At the suggestion of Sir Robert Anderson, chairman of the Corporation Tramways and Electricity Committee, an exhibition is to be held at the Town Hall, demonstrating the use of electricity for lighting, heating and power.

BURY ST. EDMUNDS.—A Local Government Board inquiry has been held into an application for powers to borrow £1,463 for purposes of electric lighting extension. It is proposed to lay down a 200 kw. plant.

DARTFORD.—The Urban Council are applying for powers to borrow £11,000 for extension of their electricity works.

DUNDEE.—Mr. T. C. Keay, electrical engineer, Baltic-street, Dundee, has received the contract for fitting up 500 electric lights for stairs in the city. His price was £323 3s. 9d.

GREYSTONES.—The Rathdown No. 2 District Council have been anxious to light Greystones by electricity and applied to the Local Government Board for powers to raise a loan for the purpose, but the Board has replied that this cannot be done until a Provisional Order is obtained from the Board of Trade.

LEEK.—The Council are laying a main, at a cost of £20, in order to supply the Leek Spun Silk Company with current for lighting purposes.

LLANDAFF AND DINAS POWIS.—An electric lighting substation is to be put up at Whitchurch by the Rural District Council. Mr. J. A. Sant, of Cardiff, is the architect.

PETERBOROUGH.—At the Local Government Board inquiry into an application for power to borrow £2,100 for new mains, opposition was offered on the ground that the deficit in the works since they were opened, amounted to £7,547. In 1907-8-9 there were surpluses totalling £214, but last fiscal year there was a loss of £1,801 owing to extraordinary expenses.

RAMSBOTTOM.—The Lancashire Electric Power Company's mains are now laid and the local transformer station is in working order, by which low tension current is made available. A number of manufacturers and tradesmen have already become consumers of electricity for power and lighting purposes.

STALYBRIDGE.—A Local Government Board inquiry has been held with respect to an application of the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board for sanction to a loan of £22,268 for electricity purposes.

SWANSEA.—In the Corporation delegates' report of the Municipal Electrical Association's meeting at Glasgow, reference is made to the approaching need for extension of the electricity works. It was, however, stated that the use of exhaust steam turbines would not be suitable to local needs.

OVERSEAS.

BOMBAY.—In deference to a general expression of opinion from consumers and the Corporation, the Bombay Electric Supply & Tramways Company, Ltd., have offered to abolish the maximum demand tariff and to substitute for it the following scale: A uniform flat rate of 5 annas per unit for electrical energy consumed for all purposes, subject to a cumulative discount of 3% upon each completed amount of 250 units consumed monthly, provided such discount does not in any case exceed an aggregate discount of 45% on the amounts to be charged.

CORDOBA.—Some time ago, due to the shortage of water in the San Roque dam, the Cordoba Government built a steam power house in the city, so as to make up the shortage in the output of the hydro-electric station. As the Electric Light Company has now built a new steam station in the city, the Government station is no longer required, and it will shortly be put up for sale, with an upset price of $150,000 m/n.

LANAULI.—News comes from Bombay that a company is being formed for the storage of water and generation of electricity at Lanauli, in the Western Ghats, which will be transmitted to mills and factories in Bombay. This company has a capital of 170 lakhs of rupees (£1,133,220), 70% of which has been subscribed. It is proposed to furnish 30,000 h.p., with a reserve of 10,000 and possibilities of expansion to 50,000. It is the biggest industrial enterprise inaugurated in India except the Tata Ironworks. The issue is under the auspices of the Tata firm.

THE HAGUE.—The Dutch Minister of Finance has issued a decree relating to Customs charges, by which it appears that electric tramrail filing machines, driven exclusively by mechanical power, with which inequalities of the surface of tram rails can be removed, are admitted free.

TRACTION.

HOME.

BOURNEMOUTH.—The Corporation contemplate the reconstruction of several of the tramway lines connected with their system, and the relaying of the track between the County Gates and the Parkstone depôt will shortly be put in hand.

KEIGHLEY.—The Town Council are much inclined to adopt trackless trolley vehicles for certain districts, and to facilitate this a sub-committee of the Tramways have been empowered to visit places where this system is at work.

NEWCASTLE-ON-TYNE.—The Tramways Committee have recommended the carrying out of a long deferred scheme for extending the tramways through Shieldfield by way of Clarence-street and Sandyford Brewery, and across to Heaton Cemetery linking up the Shields-road system by way of Chillingham-road. The sub-committee is also of opinion that the Corporation should adopt a trackless trolley system to connect Scotswood and Newburn and Blaydon. On this subject it was suggested that a conference should be held with the representatives of Newburn and Blaydon Councils and the Newcastle Council.

REDRUTH.—A new agreement has been entered into between the Council and the Urban Electric Supply Company regarding the repair by the latter of the tramway.

TORQUAY.—As a result of a difference of opinion with the Town Council, the Torquay Tramway Company have applied to the Board of Trade to appoint an arbitrator to decide on the question of the retention or otherwise of the stud system.

WEYMOUTH.—The Town Council are considering the report of the Electric Lighting Committee on traffic facilities. Schemes have been drawn up for both trackless trolley service and tramways, the latter being most favoured.

OVERSEAS.

BOYOTA, COLOMBIA.—In order to avoid riots and international complications, the municipality has bought the American tramway system there for £160,000.

SANTA FÉ.—A local correspondent says that some twelve months ago the Municipality called for tenders for the electrification of its tramways. Several proposals were received, but for some reason or other all were rejected. Fresh tenders have just been received and it is stated that none of them are as advantageous to the Corporation as those presented previously. The reason of all these delays is due to the fact that the Council do not see their way to call in technical advice; they have preferred to do it all off their own hat, and have got into a pretty mess over the job.

COMPANIES' MEETINGS AND REPORTS.

BLACKPOOL AND FLEETWOOD TRAMS.

At the half-yearly meeting, Mr. R. H. Prestwich, of Manchester, vice-chairman, presided. The half-year's accounts showed a balance of profit, with the sum brought forward and after providing for debenture interest, of £5,278, and the directors recommended a dividend at the rate of £4 per cent. per annum, which absorbs £3,000; writing off £750 to depreciation reserve, and £500 to general reserve, and leaving a balance of £1,028 to carry forward. The number of passengers carried was 997,574. Receipts from all sources were £11,997, of which £11,341 was for traffic, £210 for advertising, £58 sundries, and £235 interest. The amount paid for rates, taxes, and insurance was £549

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compared with £1,054 in the corresponding half-year), as a result of the winning of the recent rating appeal, which causes the track on the urban districts to be rated at a quarter instead of the full rate.

The Chairman said it was found that the Fleetwood side of Blackpool had a strong opponent in the fair ground at South Shore, and he thought they might congratulate themselves on being able to show such sound results as they did.

YORKSHIRE ELECTRIC POWER.

The directors state that they have pleasure in reporting that the growth of the company's business is proceeding steadily and satisfactorily. The company's customers have increased their demands and a number of important new customers have been connected during the half-year. The receipts from the sale of energy and for work charged out to consumers, etc., for the half-year ending June 30 last amount to £16,675 10s.; against for the half-year ending June 30, 1909, £11,169 4s. 2d.; and for the half-year ending June 30, 1908, £8,698 9s. The gross profit on the revenue account for the half-year is £4,950 3s. 6d., against a gross profit for the half-year ending June 30, 1909, of £2,598 12s. 11d, and a gross profit for the half-year ending June 30, 1908, of £1,249 16s. After payment of mortgage interest (£799 10s. 10d. more than the corresponding half of last year), the net revenue account shows a profit on the half-year just ended of £2,621 17s. 8d., compared with a profit for the corresponding half-year in 1909 of £1,069 17s. 11d., and a profit for the half-year ending June 30, 1908, of £363 6s. 10d. Further remunerative business is being pressed upon the company in districts not yet covered by the company's mains, but in order to meet this further capital is required. On February 15 last, at an extraordinary meeting, a Bill giving power to issue a portion of the unissued shares of the company as preference shares, and for other purposes, was submitted to the shareholders. This Bill, with slight alterations, received the Royal Assent on July 26. In June, a draft prospectus proposing an issue of £100,000 of 6% cumulative preference shares was sent to each shareholder, and on July 5 a conference of the shareholders was held, when the proposals of the directors were unanimously agreed to.

COMPANIES REGISTERED.

CARTMAN & COMPANY.—Capital, £5,000 (£1). To take over the business of electric piano and musical instrument manufacturers and merchants carried on at Manchester as the Tel Electric Company. Agreement between C. E. Cartman and T. S. Chadwick. Private.

D. H. SYNDICATE.—Capital, £500, in £1 shares. Objects: To carry on the business of mechanical, and electrical engineers, machinists, fitters, manufacturers of carriages, cycles, wagons, trucks, locomotives, motors, engines, boats, rolling-stock and conveyances, etc. Private company. The first directors (to number not less than two nor more than five) are to be appointed by the signatories. Remuneration, as fixed by the company. Registered office, 1, Sandys-row, Bishopsgate-street, E.C.

ORIZABA TRAMWAYS SYNDICATE, LTD.—Capital £3,150, in 3,000 Ordinary shares of £1 each and 3,000 Deferred shares of 1s. each. Objects: To carry on the business of tramway, railway, omnibus and van proprietors, carriers of passengers and goods, manufacturers of and dealers in trucks, tramways, accumulators, dynamos and locomotives, etc., and to acquire any tramways in Orizaba, Mexico. Private company. The provisional directors are M. E. Williams and J. E. Stevens.

WILLIAM LLOYD COOPER.—Capital, £1,000 (£1). To take over the business of marine, electric, and general engineers, boiler-makers, shipsmiths, coppersmiths, ship and wherry owners, wharfingers, etc. Private.

W. H. MITCHELL & COMPANY.—Capital, £2,000, in £1 shares. Objects: To carry on the business of mill furnishers, engineers, merchants, wholesale and retail ironmongers, electrical and general engineers, etc. Private company. The first directors are to be appointed by the signatories.

PATENTS.

Electric Plugs.

12452.—1909. H. J. FISHER, Durham. In addition to the main conductors being led into the plug and attached to metal sockets brought into contact with corresponding pins arranged in a plug box, the two subsidiary conductors which form a portion of the subsidiary electric circuit are led into the plug and are connected to other subsidiary sockets brought into contact with pins connected electrically to the framework of the machine in such manner that when the plug is fully inserted into the plug box the subsidiary electric circuit is completed.

Wireless Telegraphy Mast.

17215.—1909. S. EISENSTEIN, St. Petersburg. This improved collapsible mast comprises a number of horizontal members which are arranged at right angles one to the other. All the ends of the members are connected hinge fashion by strut members. The ends of the parallel horizontal members are united by tension cables.

Electric Incandescent Lamp Fittings.

17230.—1909. WARDLE ENGINEERING COMPANY, LTD., Manchester. A piston and cylinder are secured to the lamp and its support. A spring arranged between the piston and cylinder takes the weight of the lamp. Any vibration of the support cannot injure the filaments as the spring allows the whole lamp to move without any independent movement of the fitting.

Electric Switches.

17274.—1909. H. R. SCHULTZ, Manchester. Automatic overload and no-volt tripping devices are provided for opening the switch which is held in its closed position against the action of gravity by means of a trigger lever. The trigger lever is held in position by a locking lever. The over-load or no-volt tripping device releases the trigger lever when operated and thus opens the switch.

Preventing Fraud in Connection with Electricity Meters.

17488.—1909. G. BERARDI, Genoa. Frauds and thefts are often effected in connection with electricity meters by bringing a magnet flux near the meter which causes the recording mechanism to slow down or stop so that the current is consumed without being registered. In order to prevent or notify such fraud an appliance is provided consisting of a system of contacts freely suspended and inserted in the shunt circuit of the double circuit indicating device. When this system of contacts is operated by an outside magnetic flux the shunt circuit operating the double circuit is closed and a breakage or reduction of the main current is caused, or an indicator is actuated to show fraudulent tampering.

Electro Magnetic Separator with Rotating Magnet Drum.

17490.—1909. F. STEINERT, AND H. STEIN, Cologne. Each magnet core of the separator has a double wire winding or more than one coil. The contacts are so arranged that for the part of the circumference of the drum to be magnetised during a certain period of its rotation a current flows through both wires of the winding or the coils of the magnetic cores in the same direction. For the other part of the circumference of the drum which is to be non-magnetic, the current flows through one wire of the winding or a part electrically equal to the other part of the coils in each of the corresponding magnet cores in the opposite direction.

Induction Motors.

17520.—1909. J. H. HOLMES, Newcastle-on-Tyne. In this induction motor of the slip ring type the short circuited switch is held in its closed or short circuiting position solely by spring pressure which is overcome by pressure on the operating handle when the switch is opened and the short circuit is removed. The handle and the axially movable and rotatable connection are each provided with a rubbing surface. When the handle is actuated to open the switch the two rubbing surfaces are first moved into contact and then the connection is moved axially by reason of the engagement of the surfaces and against spring pressure in a direction to move the switch into its open position.

Electrical Means for Magnifying Small Mechanical Effects.

17555.—1909. E. S. HEURTLEY, Oxford. The invention provides a means for magnifying any small mechanical movement made by electrical signalling or measuring instruments. The small mechanical movement is caused to act on a wire or filament which is partly immersed in liquid so as to alter the depth of immersion.

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Fog Horns.

17619.—1909. R. B. NORTH, AND C. H. KIRBY, London, W. The horn is operated at fixed intervals and for fixed periods by an electric motor which regulates the intervals and periods of sound as well as drives the horn. A brake is provided to ensure cessation of the sound at the correct time.

Reversible Variable Speed Dynamos.

17847.—1909. H. LEITNER, Woking. In this speed dynamo which has subsidiary brushes, the field excitation is furnished by the brushes only or mainly. The subsidiary brushes are advanced very considerably from the centre of the pole immediately behind in the sense of rotation so that their E.M.F. never reaches quite a zero value, or at least not a negative value. A further patent (8219-1910) provides the employment of broad brushes which take the place of the main and subsidiary brushes.

Secondary Batteries.

18098.—1909. F. R. LEWIS, Lingfield. This secondary battery comprises a series of coaxial tubes, the intermediate ones of which are formed with active surfaces covering the whole area of both sides. One side has positive surfaces, while the surfaces of the other side are negative.

Electrical Switches.

18471.—1909. J. H. TUCKER, Birmingham. This is an improvement in switches of the tumbler type, in which the contact arm has a quick fly on and fly off action. The switch is provided with a rocking handle carried by a bridge piece. A contact arm is pivoted to the switch, and upon the same lever rocking is also pivoted a two-arm lever, one arm of which points in an opposite direction to the contact arm. The other arm of the lever is engaged by the lower end of the rocking handle and is rocked in one direction or the other as the handle is operated. Between the contact arm and the free end of the lever is a spring. When the handle is moved over to the opposite position the two-arm lever is also moved and carries with it one end of the spring which at the same time is put into greater tension. As soon as the spring passes the centre upon which the contact arm is pivoted, the tension causes the contact arm to fly over. The same action takes place when the handle is moved in the opposite direction.

Soldering Incandescent Filaments.

25383.—1909. COMPAGNIE GENERALE D'ELECTRICITE, Paris. This apparatus for soldering the filaments of electric lamps to their holders comprises resistances of a material which will stand high temperatures fixed to supports provided with a regulating arrangement which allows of displacing them so as to bring the resistances simultaneously close to the points to be soldered. The resistances are connected to a source of electricity which brings the mto incandescence and causes the end of the holders to melt under the action of the radiant heat.

Electric Gas Lighters.

25574.—1909. F. F. DIER AND W. C. W. WHITCHER, Ottawa. The lighter comprises two relatively movable electrode members, one of which carries a yielding contact member adapted to make and break contact with the other electrode member and thus produce a spark. The yielding contact member of one electrode has a projection which extends into a perforation in the other member. The electrode members are carried by a hollow handle which contains a switch operated by the longitudinal movement of one of the members.

Electrolyte for Use in Batteries.

26649.—1909. NEW IGNITION SYNDICATE AND J. L. SANDY, London, E.C. 32 oz. bichromate of soda, rendered anhydrous, are mixed with 18 oz. fluid concentrated sulphuric acid. The resultant mass is ground to a fine powder and mixed with 4 oz. salt and sufficient water to obtain a density of 52° Tw.

Accumulator Plates.

27976.—1909. H. DE LAMINIERE AND SOCIETE ANONYME DES ACCUMULATEUR DE LAMINIERE, Laon. The improved paste for forming accumulator plates consists of a mixture of oxide of lead with a solution in distilled water of potassium tartrate, sodium tartrate or a double tartrate of potassium and sodium. On being dried in the open air the paste sets and acquires a hardness equal to that of cement. It is claimed to be absolutely proof against the action of sulphuric acid and to last for a practically indefinite time.

Metal Filament Lamps.

349.—1910. O. KRAUSE, Berlin. The supporting device for the whole of the filaments surrounds an elastic stem to which it is elastically connected, besides being connected by springs to the lamp foot.

Electric Switches.

5571.—1910. A. H. MIDGLEY AND C. A. VANDERVELL, London, W. This switch is so constructed that it can be used with a dynamo, battery and lights. All the negative and return leads are brought to a central terminal and the various connections are made on the positive side.

Electric Signalling Apparatus.

7154.—1910. SIEMENS AND HALSKE, A.G. Berlin. This is an improvement in signalling apparatus comprising transmitters of any suitable construction and freely oscillating receivers. A damping device (the regulation or retarding mechanism of which is not included in the circuit of either the field or armature of the transmitters or receivers) controls the closing or opening of the circuits which affect the setting of the receivers in such a manner that the closing or opening of the circuits is maintained throughout and beyond the movement of the transmitter.

Starting Polyphase Electric Asynchronous Motors.

7822.—1910. SIEMENS SCHUCKERTWERKTE, G.m.b.H., Berlin. This arrangement for facilitating the starting up of polyphase electric asynchronous motors consists in connecting the resistance of a controlling switch in series with the rotor winding of the motor and with the alternator winding of the motor generator.

Polyphase Electric Compensated Series Motors.

9046.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. The main exciting field is produced by current components of suitable phases either in the ocmpensation or armature windings. This does not interfere with the other functions of the windings. The strength of the main field may be varied independently of the load current as required.

Electric Switches.

10423.—1910. A. P., G. C. AND P. A. LUNDBERG, Islington. The legs of the bridge piece of this tumbler switch are spaced farther apart than is usually the case so as to provide more room for the switch movement. The lower ends of the legs have additional flanges so as to provide a greater bearing surface for the bridge.

Power Transmission Mechanism.

10843.—1910. F. L. MORSE, Ithaca, U.S.A. The links of the drive chain are composed of a number of plates. The plates of one link are interspersed with the plates of the adjacent linking. Spacing pieces are interposed between the plates of a link to which they are rigidly fastened.

Centrifugal Fans for Vacuum Cleaners.

5376.—1910. ELECTRO RENOVATOR MANUFACTURING COMPANY, Pittsburg, U.S.A. The fan casing has a portable hollow base in which an electric motor is carried. A shaft extending from the base carries the fans. Each fan has a number of curved blades fixed to a disc and enclosed in a separate casing, built up in sections one above the other and secured by bolts. Each section is complete in itself and any number of fans may be employed.

Electromagnetically Actuated Switches.

5801.—1910. CUTTER HAMMER MANUFACTURING COMPANY, LTD., Milwaukee, U.S.A. This is an improvement in switches in which there is a blow-out magnet provided with pivoted pole pieces which can be swung aside to permit access to the switch contacts. In order to facilitate the outward movement of the pole pieces they are arranged to turn about the same axis as the core of the blow-out magnet. This enables the pole pieces to be rapidly moved into and out of position and a strong magnetic field obtained with a low expenditure of energy in the blow-out coil.

Electric Frequency Converters.

7292.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. The invention consists of an improved stator winding which, besides producing the desired main or exciting field, is of such a nature that the strength of the main field is zero in the regions of the short circuited armature coils. The invention also provides a commutation winding connected in series with the main field winding and which serves to produce a commutation flux of a value and direction suitable to compensate under the normal condition of working of the frequency converter for the conditions which produce sparking at the commutator brushes other than those due to the action of the main field. A second small independently excited auxiliary commutation winding may also be provided in the circuit with which a voltage or phase transformer or both may be connected.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.						Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Aug. 24	1,591	1,568	+ 22	— 331	27¼	27¼	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Aug. 21	1,096	1,044	+ 52	+ 510	24·089	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	Aug. 20	6,595	6,252	+ 343	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Aug. 20	5,424	5,250	+ 174	+ 3,295	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Aug. 28	1,255	1,292	— 37	— 98	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Aug. 26	6,163	5,742	+ 421	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Aug. 27	1,260	1,270	— 10	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Aug. 28	323	281	+ 42	— 16	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Aug. 27	4,744	4,549	+ 195	+ 2,425	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27*a*
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Aug. 28	3,079	1,891	+ 188	+ 195	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Aug. 25	520	504	+ 15	+ 1,020	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Aug. 12	1,745	1,843	— 98	+ 3,270	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Aug. 26	183	181	+ 2	+ 47	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Aug. 26	6,985	6,848	+ 137	+ 322	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Aug. 27	1,061	987	+ 74	+ 520	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Aug. 20	17,558	17,261	+ 297	+ 11,179	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Aug. 27	2,772	2,571	+ 200	+ 3,324	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Aug. 24	139	147	— 8	— 164	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Aug. 24	1,308	1,313	— 5	— 572	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Aug. 21	1,440	1,501	— 61	+ 2	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Aug. 17	41,373	37,276	+ 4,097	+ 112914	136	119½	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100		—	7·4		—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Aug. 27	9,124	8,319	+ 505	+ 5,190	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Aug. 28	15,786	15,242	+ 544	+ 4,589	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Aug. 20	3,869	3,802	+ 67	+ 912	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Aug. 21	5,994	5,477	+ 517	+ 7,483	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Aug. 17	1,281	1,253	+ 27	+ 496	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 10	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Aug. 27	1,023	966	+ 56	+ 63	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	— 97	+ 1,985	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *h* Half-years' figures.

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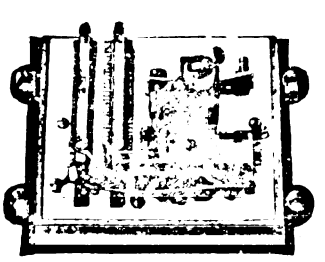

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NOTES.

The Magic of Electricity.

Thanks to electricity, Mr. Thomas Edison appears to have solved that dream of the ancient magicians—the actual reproduction of past scenes. By a combination as yet unexplained of the kinematograph and the phonograph not only can scenes be reproduced, but the figures re-enacting their activities also reproduce the sounds connected therewith. It is a wonderful enough achievement, and one can hardly yet grasp its future; but one thing seems pretty evident, it is likely to give an immense impetus to the picture theatres, and that will mean more business for manufacturers and an increased outlet for central station energy.

Regenerating Carbon Lamps.

Herr Schmittutz, speaking at the Electrotechnic Society of the Lower Rhine, described a method employed by a firm of lamp manufacturers at Esens to renew exhausted carbon lamps. The method is always applicable provided the filaments are not broken. The cap is unsealed and air is allowed to penetrate inside the globe, which is then raised to a high temperature from the outside, by which means the carbon deposit on the inside of the lamp is burnt away. Then the air is exhausted and carburetted hydrogen is introduced, the lamp is next connected with the electric circuit and current switched on. As the filament glows it absorbs carbon. As soon as the filament has regained its original section the lamp is switched off, finally sealed, and is then ready for use again.

Electricity and Cottage Property.

Mr. J. A. Bell, electrical engineer to the City of Aberdeen, is able to make a remarkable statement in his annual report. While admitting that the department still suffers from a fall of consumption as a result of the introduction of metallic filament lamps, he remarks that this is rapidly being compensated for by reason of the great extension that the use of electric light has taken. He says: "In our Deeside districts, for instance, the smallest cottages are now regularly wired for electric light." He adds: "The Aberdeen architects are, to a large extent, still installing gas for lighting purposes in small houses within the city, and I am inclined to think they neglect the fact that a thoroughly sound and satisfactory installation of electricity is as cheap to instal—and, nowadays, practically as cheap light for light—as gas irrespective of the many incidental advantages which electricity can claim." This phenomena of electricity being used in small villas and cottage property is not, of course, confined to Scotland, but it is a good argument that if those true domestic economists, the Scots, find electricity cheap in the long run, it really is so. To encourage this extension three things are necessary: education of the architects and public, cheap systems of installation, and simple, reliable wiring. It is the question of installation that is the chief stumbling-block to universal use.

Tramway Enterprise.

Sir Clifton Robinson is surely unduly pessimistic in thinking that the very large municipalisation of our tramways by shutting out private enterprise, is going to hamper extension in this country. Sir Clifton seems to argue that the linking up of different urban systems could only be undertaken by privately-owned undertakings, but the wonderful network of trams in the north, especially Lancashire and Yorkshire, where town after town is linked up, and, moreover, great feelers run out into rural districts, appears to belie this. Then we have the movement in London to co-ordinate all forms of mechanical traction, strikingly shown by the London County Council decision to seek powers for interchange of traffic with other organisations. With commonsense and goodwill, there is no reason why the "unprofitable linking" up of different systems should not be undertaken by mutual agreement among public bodies. The real danger to sound extension is, of course, strenuous opposition from railway and landed interests in Parliament.

"Wireless" and Aviation.

Probably in about three or four weeks time the great airship "America" will start on the bold attempt to cross the Atlantic, carrying a daring crew of six. Practically she will be watched all across the ocean, until she reaches England or the Continent. A member of the crew is Mr. Irwin, a young Australian, and late "wireless" operator on the American liner "St. Louis." He will have charge of radio-telegraphic equipment installed by the Marconi Company, which has a radius of between 70 and 90 miles. This is considered quite adequate for telegraphing over the waves or from the clouds to passing ships. The "America's" call number is "W." For night work there is a range of electric lanterns designed to transmit flash-lights on the Morse code system. So it will be seen that if airships are not yet electrically driven, electricity is destined to play a big part in safety and utility equipments.

Electrical Furnaces.

While the Swedish Electro Metal Company, formed a short time ago to take up the invention of three Swedish engineers, Messrs. Lindblad, Gronvall and Stalbane, and working the patents in England and the British Colonies, is putting up a larger trial furnace at Trolhatten, the Electro Metal Company over here is about to instal one of the furnaces at Sheffield. This is a mixed process, as the actual reduction is accomplished by means of coke, while the high temperature is produced by electricity. It is said by this means there is a saving of two-thirds of coke used, while it is estimated that the production of pig iron will be 2½ tons per h.p. year. Great hopes are entertained of its success, especially in the colonies, Canada, for instance, where hydro-electrical energy is available.

"Duralumin."

If, on long and varied practice and in open competition, "Duralumin" proves as good as the discoverers, Messrs. Vickers, Sons & Maxim, have reason to hope, they will have conferred a boon on industry in general, and on Birmingham in particular. Mr. H. B. Weeks, chief chemist to the firm, says that this new alloy, while heavier than aluminium is only one-third the weight of brass. It is a useful metal, for at suitable temperatures it can be rolled, drawn and stamped. So far, we have not heard what its electrical properties are. "Duralumin" is to be produced on a large scale at Birmingham, and will probably be ready for the market by October.

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Municipal Lace Factories.

A proposal for the erection of municipal lace factories is being canvassed in Nottingham. For some time past there has been a great difficulty as regards extension of the industry owing to absence of suitable factory sites, and the consequence is that factories have been built in outlying villages. As the result of this there has been considerable hardship in the distribution of labour. It is now proposed to build one or more municipal lace factories, which would be equipped with the latest types of costly machinery, "stands" being let to manufacturers. The idea seems to be hailed with appreciation by both manufacturers and workers. From the municipal point of view it would be a good move, as the necessary capital could be borrowed at 3½%, and fair rents realised. Moreover, ratepayers would be kept within the borough limits, the premier trade of the locality would be assisted, and an increased demand for municipal electricity would be created.

Mussels Obstruct Electricity.

Obstruction to electrical progress comes from many quarters, but even when bipeds are at work their tactics are not so very different from those adopted by the mussels of Brighton, Plymouth and Southampton. They display tenacity in the wrong place. Mr. John Christie has a fairly tough job before him, but meanwhile his report, printed elsewhere in this issue, affords a certain amount of amusing reading. The suggestion for the electrocution of the mussels, it appears, cannot be carried out any more than it can be with human obstructionists, which is rather a pity.

Russian Exhibition of Electrical Railways.

As regards the postponed International Exhibition for Demonstrating the Application of Electricity to Railways, which is to be held at St. Petersburg from April to July of next year, under the auspices of the Imperial Government, further particulars are now to hand. Applications for space must be made to the President of the Organising Committee of the Exhibition, Mr. N. A. Sitenko, at 24, Sadvaia, St. Petersburg, before the middle of February.

Electric Lighting Further Powers Bill.

Since last week, the Incorporated Municipal Electrical Association have received further accessions to the movement for securing an amending Act. Both Wolverhampton and Greenock have promised active and financial help while Bray is giving moral support.

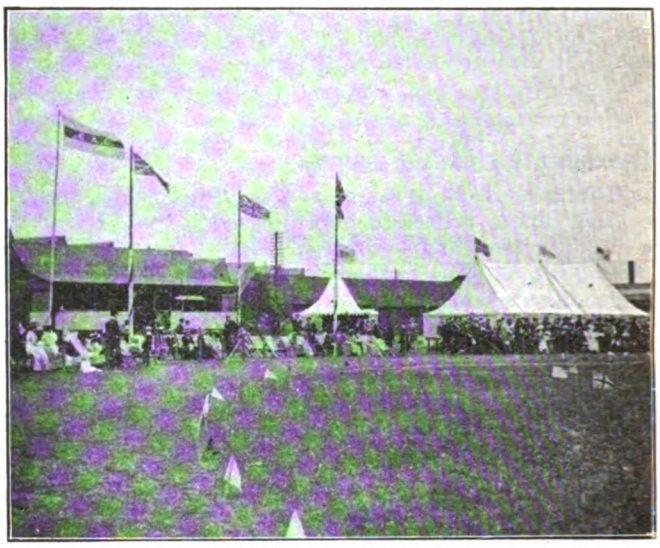
Metallic Radium.

By a piece of good fortune which is rare in science, the honour of putting the coping stone on a momentous discovery has fallen to the lot of the surviving co-discoverer. Madame Curie, who with her late husband opened to the world a knowledge of the wonderful radium, has placed before the French Academie des Science a report on the successful isolation of metallic radium, which had hitherto only been seen in its salts. Associated with her in this latter work was Monsieur de Bierne. The metal is highly oxidisable, and from a clear white soon becomes black. It adheres firmly to iron, decomposes water, burns cellulose, and is rapidly dissipated. This pure element was obtained by electrolysis of the salt, by which means a milligramme of radium amalgam was secured, and on distilling off the mercury at a temperature of about 700° C., the pure metal was left behind. It appears to be immensely powerful. The whole civilised world will join in congratulating Madame Curie and her collaborateur. Meanwhile Dr. Albert Churchward, of Norwood, has been experimenting with a radio-active ore, of a greenish-brown colour, quite unlike radium bearing ores, obtained from Portugal. Its radio-activity is remarkable, and apparently its curative properties are great, for Dr. Churchward has succeeded in arresting, if not eradicating, rodent ulcers. Its properties are now being investigated at Guy's Hospital, where the science of radio-active therapeutics is very advanced. Quite apart from its curative properties, however, this new radio-active ore should prove of considerable scientific value, as facilitating the study of radio-activity generally and the theory of electrons. It is far more abundant and more active than pitch-blende.

CALLENDER'S SPORTS.

Although the employees of Callender's Cable & Construction Company, Ltd., have boasted an athletic club for five years, it was only on Saturday, August 27, that they essayed a public meeting, which was held on the club grounds at the works at Belvedere. The weather was propitious: there was a fair amount of sunshine, and, despite the strong wind, some exceedingly good times were made by the sprinters. All praise is due to the officials and their assistants for the admirable arrangements which had been made, and the entire programme was carried out like clockwork to schedule time without a hitch or a flaw. Most elaborately had the ground been prepared for the event with gay decorations, seating accommodation, marquees, refreshments, and, to the no small comfort of the competitors, a masseur had been engaged to administer to their needs. The spectators numbered some 2,000, and Callender's Prize Band was in attendance.

Great interest centred in the tug-of-war, for which no less than 16 teams contested, Plumstead Police, however, proving victorious. A popular event was the obstacle race,



CALLENDER'S FIRST ANNUAL SPORTS.

hilarity being provoked as the competitors encountered the swinging bar placed 5 ft. 6 in. from the ground, the greasy board, crawling under a pole close to the ground, the spread canvas, to say nothing of the swinging barrels, and the hurdle and water jump. The race resulting in a dead heat, first and second positions were decided by the spinning of a coin. Another interesting event was the employees' veterans race, and, after six events had been disposed of, the 100 yards was done in 13 sec. from the 10 yards' mark by a competitor of 47. The high jump also deserves notice, the first prize being secured by a junior of 17, who cleared the bar at 4 ft. 11 in.

Ladies also came in for their share of the day's sport in the egg and spoon race, and the winner received an ovation as she successfully passed the tape.

The prizes were gracefully presented by Mrs. Walker, the wife of the works manager, and, after one or two complimentary speeches, dancing was commenced on the green to the accompaniment of music supplied by the works band until 9 o'clock. Altogether the meeting was pronounced a tremendous success.

ELECTRICAL ENGINEERS' CONCERT.

The Bohemian concert of the Electrical Engineers (London Division), which was postponed on account of the death of King Edward, will be held in the Pillar Hall, Victoria Station (S.E. & C. Railway), on Saturday, October 15th, at 7.30 p.m. Tickets and full information can be obtained from the secretary, C.S-M., A. E. Dixon, at the headquarters, Regency-street, S.W.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION (INCORPORATED).—The next committee meeting of this association will be held at the offices, Balfour House, Finsbury-pavement, on Tuesday, the 13th inst., at 2.30 p.m.

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THE BRITISH ASSOCIATION.

Electrical Topics.

Several papers of interest to the electrical industry were read at the eightieth annual meeting of the British Association, just held at Sheffield. The Association, by the way, will hold its meeting next year at Portsmouth; in 1912 at Dundee; in 1914 in Australia.

Electrical Railways.

Professor W. E. Dalby, in his presidential address before the Engineering Section, dealt with British Railways and their Workings. After a lengthy review of steam traction. he referred to the great importance of speed.

Mr. James Holden, until recently locomotive engineer of the Great Eastern Railway, he pointed out, built an engine to produce an acceleration of 30 m.p.h. in 30 secs. with a gross load of 300 tons. The engine weighed 78 tons, and was supported on 10 coupled wheels each 4 ft. 6 ins. diameter. There were 3 high pressure cylinders, each 18½ ins. diameter and 24 ins. stroke. A boiler was provided with 3,000 sq. ft. of heating surface and a grate of 42 sq. ft. area. Boiler pressure, 200 lbs. per sq. in. This engine practically reached the limit of the construction gauge.

An acceleration of 30 m.p.h. in 30 secs. is considerably below what may be applied to a passenger without fear of complaint, but it is clear that it is just about as much as a locomotive can do with a train of reasonable weight. Even with a gross load of 300 tons nearly one-third of it is concentrated in the locomotive, leaving only 200 tons to carry paying load. The problem of quick acceleration cannot therefore be properly solved by means of a steam locomotive. But with electric traction the limitations imposed on the locomotive by the construction-gauge and by the strength of the permanent way are swept away.

The equivalent of the boiler power of a dozen locomotives can be instantaneously applied to the wheels of the electric train, and every axle in the train may become a driving axle. Thus the whole weight of the stock, including the paying load, may be utilised for tractive purposes. If, for instance, the train weighed 200 tons, then a tractive force equal to one-fifth of this, namely, 40 tons, could be exerted on the train, but uniformly distributed between the several wheels, before slipping took place. The problem of quick acceleration is therefore completely solved by the electric motor.

Then coming directly to the subject of electric railways, Professor Dalby claimed that December 18, 1890, was memorable in the history of railway enterprise in this country, for on that date the City and South London Railway was opened for traffic, and the trains were worked entirely by electricity, although the original intention was to use the endless cable system of haulage. This line inaugurated a wonderful system of traction on railways in which independent trains moving at different speeds at different parts of the line are all connected by a subtle electric link to the furnaces of one central station.

Since that epoch-marking year electric traction on the railways of this country has made a gradual if somewhat slower extension than anticipated. But electrically-operated trains have in one branch of railway working beaten the steam locomotive out of the field and now reign supreme—that is, in cases, as indicated above, where a quick frequent service is required over a somewhat short length of road. The superiority of the motor over the steam locomotive, apart from questions of cleanliness, convenience, and comfort, lies in the fact that more power can be conveyed to the train and can be utilised by the motors for the purpose of acceleration than could possibly be supplied by the largest locomotive which could be constructed within the limits of the construction gauge. There are many other considerations, but this one is fundamental and determines the issue in many cases.

A few facts relating to the present state of electric railways in the United Kingdom may prove of interest. At the end of 1908 there were in the United Kingdom 204 miles of equivalent single track worked solely by electricity and 200 miles worked mainly by electricity, corresponding to 138 miles of line open for traffic. Of this 102 miles belong to the tube railways of London and 20 miles to the older system formed by the District and the Metropolitan Railways and their extensions.

It is not an easy matter to ascertain exactly how much capital is invested in these undertakings for the purpose of electric working alone, since some of the lines originally constructed for a steam locomotive service have been converted to electric working. On the converted lines there is the dead weight of capital corresponding to the locomotive power provided before electrification took place. The capital invested in the 102 miles of tube railways in London is a little over £25,000,000.

The total number of passengers carried (exclusive of season tickets) on the 138 miles of electrical track during the year 1908 was nearly 342 millions, being roughly one-third of the total number of passengers carried on all the railways of England and Wales during the same period.

The average cost of working this traffic is 22·3d. per train-mile. This figure includes the service of the lifts, which is presumably returned with the traffic expenses. The charges work out in this way :—

Average Working Cost per Train-mile of the Electric Railways worked wholly or mainly by Electricity in England and Wales for the Year 1908.

	Pence per Train-mile.
Locomotive power	8·40
Repairs and renewals of carriages and waggons	1·50
Maintenance of permanent way ..	2·40
Traffic expenses	5·22
General charges	1·52
Rates and taxes	2·36
Government duty	0·088
Compensation	0·116
Legal and miscellaneous	0·75
Total	22·35

The corresponding total receipts were 38·65d. per train-mile. The working expenses are thus 58% of the total receipts. Comparing this with the figures given above for the whole of the lines in England and Wales, it will be seen that the cost for locomotive power on the electric railways appears to be about two-thirds of the cost on steam lines per mile run, the cost for repairs and renewals of carriages and waggons about one-half, and the cost for traffic expenses about one-half.

The two kinds of working are not, however, strictly comparable, as all the conditions of traffic in the two cases are different and the length of the electric lines is relatively so small that the problems which arise out of the transmission of electric power over long distances are excluded. The traffic expenses and the cost of repairs and renewals of carriages and waggons, general charges, etc., are practically independent of the kind of power used for locomotive purposes, and, moreover, the difference in weight of electric trains and the steam-hauled trains is on the average so great that no comparison can be instituted without ton-mile statistics.*

Method of Working.

With two exceptions the method of working the electrified lines of this country is in the main the same. A third conductor rail is laid on insulators fixed to the ordinary track sleepers, and is maintained throughout the whole of its length at as nearly as possible a pressure of 600 volts, except in a few cases where the pressure is 500 or 550 volts. Collecting shoes, sliding along the rails, are fixed to the trains, and through them current is supplied to the armatures fixed to or geared with the axles. The current flows through the armature back to the stations or sub-stations through the running rails, which are bonded for the purpose, or sometimes through a fourth rail carried on insulators fixed to the track sleepers as in the cases of the District and Metropolitan Railways.

Differences in the equipment arise out of the geographical necessities of the distribution. For a short line the power is produced at a central station and is distributed by

* Much valuable information regarding the cost of converting the line between Liverpool and Southport from steam to electric working will be found in Mr. Aspinall's presidential address to the Institution of Mechanical Engineers.

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feeders to the conductor rail direct. For longer lines power is produced at higher voltage (11,000 volts in the case of the District Railway), and is then distributed to sub-stations conveniently placed along the line, where it is transformed to a lower voltage, converted to direct current, and then by means of feeders is distributed at 600 volts or thereabouts to the third rail.

In 1908 the Midland Railway Company opened for traffic the electrified line connecting Lancaster, Morecambe, and Heysham. The method of electrification was a departure from the general direct current practice hitherto applied to electrified lines in this country. Power was supplied to the trains at 6,600 volts, single phase, at 25 alternations per sec., along an overhead conductor. The pressure was reduced by transformers carried on the motor-coach itself, and was then used by single-phase motors. The traffic conditions on this line are simple.

In December, 1909, the electrified portion of the London, Brighton and South Coast Railway from Victoria, round by Denmark Hill to London Bridge was opened for traffic. This work marks an epoch in the history of electric traction in England. For the first time the single-phase system was applied to meet the exacting traffic conditions of a London suburban service where the main condition is that the trains should be accelerated rapidly. The system has shown that it can meet all the conditions of the service perfectly. Energy is purchased and is distributed by overhead conductors direct to the trains at 6,600 volts, single-phase, at 25 alternations per sec. where it is used by the single-phase motors after suitable transformation by apparatus carried under the motor carriage. The results of this electrification will be of unusual interest because not only has the method applied shown itself to be quite suitable for dealing with a stopping traffic where quick acceleration is the dominating condition, but it contains the germ of practicable long-distance electrification. The near future may see the extension of the system to the line between London and Brighton, giving a frequent non-stop service which would bring Brighton in point of time nearer than the suburbs on opposite sides of London are to one another.

Power Signalling.

During the last ten years a considerable number of trial installations of power signalling apparatus have been made by the railway companies of this country. The electric lines have generally adopted power signalling, and the District Railway has installed a complete system on all its lines and branches.

The term "power signalling" is applied to any equipment in which the actual movements of the points and signals are done by power, the signalman's work being thus reduced to the movement of small light control levers or switches. Of the several systems tried and proposed, three bulk largest in the equipments applied in this country, namely, the all-electric, the low-pressure pneumatic, and the electro-pneumatic systems.

The "all-electric" system is represented by installations of the McKenzie-Holland and Westinghouse system on the Metropolitan and Great Western Railways, by installations of the "Crewe" system on the London and North-Western Railway, and by installations of Siemens Brothers on the Great Western Railway. The general feature of the all-electric system is that the points are operated by motors sunk in a pit by the side of the rails, the signals are pulled off electrically, and all the apparatus is controlled electrically.

The low-pressure pneumatic system is represented by installations on the London and South-Western Railway and the Great Central Railway. The points and signal arms are moved by air compressed to about 20 lbs. per sq. in., and led to cylinders connected to the points and to the signal-arms. The control is also done by means of compressed air, small pipes leading from each air-cylinder to the cabin.

The electro-pneumatic system has found most favour in this country up to the present time. The equipment installed includes such notable stations as the Central at Newcastle with 494 levers, and the Glasgow Central with 374 levers, and the whole of the Metropolitan District system of underground railways. In this system an air-cylinder is connected to each set of points and to each signal-arm. Air compressed to 65 lbs. per sq. in. is supplied to the cylinders from a main running alongside the railway kept charged by small air-compressors placed at convenient intervals. Each air-cylinder is provided with a small three-way air-valve operated by an electro-magnet. The movement of each air-valve is controlled electrically from the cabin through the electro-magnet associated with it. The system grouped round any one signal-cabin may be regarded as an engine fitted with a large number of cylinders, each working intermittently by compressed air, and where in each the valve-rod has been changed to an electric cable, all the cables being led to a signal-cabin where the operation of the valves is done by means of an apparatus which is as easily played upon as a piano, with this difference, however, that the notes are mechanically interlocked so that a signalman cannot play any tune he pleases, but only a tune which permits of safe traffic movement. Moreover, the instrument is so arranged that the movement of the small lever determining the movement of a signal-arm cannot be completed unless the signal-arm actually responds to the intention of the signalman, thus detecting any fault in the connections between the box and the arm.

The obvious advantage of power signalling is the large reduction of physical labour required from the signalman. His energy can be utilised in thinking about the traffic movements rather than in hauling all day at signal levers. One man at a power frame can do the work of three at the ordinary frame. The claims made for power signalling, in addition to the obvious advantage of the reduction of labour, are briefly that the volume of traffic which can be dealt with is largely increased, that the area of ground required for the installation is considerably less than with the ordinary system, with its rodding, bell-crank levers, chains, and pulleys, and that where the conditions are such that power signalling is justified the maintenance cost is less than with a corresponding system of normal equipment.

Automatic Signalling.

Several of the power signalling installations are automatic in the sense that between signal-cabins on stretches of line where there are no junctions or crossover roads requiring the movement of points, the movement of the signal-arm protecting a section is determined by the passage of the train itself. The most important equipment of this kind is that installed on the group of railways forming the "Underground" system. This includes the District Railway with all its branches. On this line the particular system installed is the electro-pneumatic, modified to be automatic except at junctions. Signal-cabins are placed only at junctions and at places where points require to be operated. The stretch of line to be automatically signalled is divided into sections, and the entrance to each section is guarded by a signal-post. Calling two successive sections A and B, the train as it passes from Section A to Section B must automatically put the signal at the entrance to B to danger, and at the same time must pull off the signal at the entrance to A. These operations require the normal position of the signal-arm to be "off" instead of at danger, as in the usual practice. The position of the arm in this system conveys a direct message to the driver. If "on" he knows that there is a train in the section; if "off" he knows that the section is clear. Each signal-arm is operated by an air motor as briefly described above, but the cables from the valves are now led to relays at the beginning and end of the section which the signal protects. The contrivance by means of which the train acts as its own signalman is briefly as follows. One rail of the running track is bonded, and is connected to the positive pole of a battery or generator. The opposite rail is divided into sections, each about 300 yards long, bonded, but insulated at each end from the rails of the adjacent sections and each section is connected to a common negative main through a resistance. A relay is placed at the beginning and at the end of each section, and is connected across from the positive to the negative rail. Current flows and energises the relay, in which condition the relay completes a circuit to the electro-magnet operating the admission valve of the air-cylinder on the signal-post, air is admitted, and the signal-arm is held "off." This is the normal condition at each end of the circuit. When a train enters a section it short-circuits the relays through the wheels and

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axles, in consequence of which the relays, de-energised, break the circuit to the admission-valve, which closes, and allows the air in the cylinder to escape, and the signal-arm, moved by gravity alone, assumes the "on" or danger position. At the same time the short circuit is removed from the section behind, directly the train leaves it, the relays are at once energised, the admission-valve to the air-cylinder on the protecting post of the section is opened, air enters, and the signal is pulled down to the "off" position.

The speed at which traffic can be operated by this system of power signalling is remarkable. At Earl's Court junction box 40 trains an hour can be passed each way—that is, 80 per hour—handled by the one signalman in the box. As the train approaches the box both its approach to the section and its destination must be notified to the signalman. When it is remembered that with ordinary signalling, to take an express train, for example, a signalman hears some 24 beats on the gongs in his box, and sends signals to the front and rear box which give altogether some 24 beats on the gongs in these two boxes, 48 definite signals in all, for every express train he passes into the section which his signals protect, it will be understood that the system must be profoundly modified to admit such a speed of operation as 80 trains per hour per man. The modification is radical. No gong signals are used at all. There is a small cast-iron box standing opposite the signalman with 15 small windows in it, each about 1½ in. square. Normally, each window frames a white background. A click in the box announces the approach of a train, and a tablet appears in one of the empty windows showing by code the destination of the train. The signalman presses a plug in the box, a click is heard, and a tablet is seen in a precisely similar apparatus in the next box. When the train passes the man presses another plug and the tablet disappears.

Four wires run between the signal-boxes along the railway and by combining the currents along the four wires in various ways 15 definite signals can be obtained, a number sufficient for the District traffic. Each of the 15 combinations is arranged to operate one particular tablet in the box. Current from these four wires is tapped off at intermediate stations and is used to work a train indicator showing the passengers assembled on the platform the destinations of the next three trains. The whole equipment is a triumph of ingenuity and engineering skill, and is a splendid example of the way electricity may be used to improve the railway service quite apart from its main use in connection with the actual driving of the trains.

The facts and problems I have brought before you will, I think, show the important influence that scientific discovery has had upon our railway systems. Scientific discovery and mechanical ingenuity have reduced the cost of locomotive working to a point undreamt of by the pioneer locomotive builders. Electric railways are the direct fruit of the discoveries of Faraday. The safety of the travelling public was enormously increased by the invention of continuous brakes and by the discovery of the electric telegraph, and is greatly increased by the development of modern methods of train-lighting, train-warming, and the train kitchen. Inventions of a most ingenious character have from time to time been made in order to furnish a steady and ample light in the carriages. The smoothness of travelling on our main lines is evidence of the thought which has been lavished both on the wheel arrangements of the carriages and on the permanent way. Problems in connection with the continuous brake are many and interesting. Some of the problems of modern signalling would have quite baffled the scientific electrician a quarter of a century ago. When engineers endeavour to apply the results of scientific discovery they often find themselves confronted by new problems unperceived by the scientist. Together they may find a solution and thus enlarge the boundaries of knowledge and at the same time confer a practical advantage on the community. The pure scientist, the practical engineer, act and react on one another both to the advantage of pure science and to the advantage of the national welfare. The future success of our railways depends upon the closer application of scientific principle both to the economic and engineering problems involved in their working, some decrease in unprofitable competition with one another, and a more just appreciation on the part of the State of the part railway companies play in our national well-being.

Mechanical Hysteresis of Rubber.

Professor Alfred Schwartz, in a lengthy paper, showed that the increasing importance of the applications of rubber in the arts calls for carefully standardised tests of the properties of this material, a subject which we have already gone into fully, though in a rather different way, before the Institution of Electrical Engineers, observing that the physical properties of rubber of which use is made in industrial work are its elasticity, compressibility, extensibility, tenacity, flexibility, adhesiveness, resistance to certain chemical agents, impermeability to water, solubility in certain liquids, and electrical resistance and dielectric strength, he said that the methods of testing employed at the present time consist in chemical analysis and in the determination of the elongation and load at rupture, and of the sub-permanent set resulting from a given extension maintained for a given time.

But, he argued, it was evident that the chemical tests can give no indication with regard to many of the physical properties enumerated above, and it would seem that their true function lies in the determination of *causes*, while the mechanical tests should deal with the *effects* produced by these causes in the commercial product.

The mechanical tests should then form the primary tests of both the manufacturer and the purchaser, and should, when necessary, be supplemented by the chemical tests, either as confirmatory tests or for the elucidation of the causes of the defects indicated by the mechanical tests. In the case of raw rubbers the chemical tests give little or no indication of the value of the product for industrial purposes, and it is suggested that test pieces for such materials should be prepared from the so-called "Admiralty mixing," consisting of 60% rubber, 3% sulphur, and 37% zinc oxide, and subjected to the hysteresis tests described.

The author has designed a machine in which a specimen of rubber of standard dimensions is loaded at a given rate to a given percentage of its breaking load. The load is then removed at the same rate, and a graphical record is obtained on the chart table of the machine of the extension and retraction curves.

Rubber possesses very considerable mechanical hysteresis, and a consideration of the loop diagram obtained from the machine enables the following physical quantities to be determined for any given test piece:—

(1) The rate of extension with load.
(2) The work done in extension.
(3) The work done by the rubber in retracting.
(4) The work expended in the rubber itself.
(5) The sub-permanent set remaining after a given extension.

The limits of the hysteresis loop may also be set in terms of extension in place of load as already stated. The author finds that for a given rubber the following laws hold good:

(a) The load per unit area of the initial cross-sectional area of the test piece is constant for a given extension of the test piece and independent of the cross-sectional area of the specimen within certain limits.

(b) The work done in extension, in retraction, and in the rubber itself is within certain limits proportional to the cross-sectional area of the test piece, and is directly proportional to the length of the specimen with a given percentage extension.

On the completion of the first cycle of extension and retraction, the specimen may be subjected to a series of similar cycles, the limits of which may be set either by a given maximum extension or a given maximum load.

For high-grade rubbers, the areas of the loops for successive cycles become constant after about the sixth loop, when the subsequent cycle loops are taken up to the same maximum load as that for the first loop.

The author finds that the extension for a given load limit increases with each successive cycle, and that the rate of increase follows a logarithmic law from the second cycle onwards.

Applications of the hysteresis test are given to the determination of various grades of rubber, of the quantity of rubber in a given mixing, of the degree of vulcanisation, and of the deterioration due to age or high temperature.

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Photoelectric Fatigue.

Equally interesting, though somewhat more in the region of theoretical observation, was Dr. H. Stanley Allen's note on photoelectric fatigue. As far back as 1887 Hertz observed that the electric spark passes more readily when the spark gap is illuminated by ultra-violet light led to the discovery by Hallwachs of the photoelectric current. A negatively charged body often loses its charge rapidly when exposed to light, especially to ultra-violet light. The discharge is due to the emission of negative electrons from the illuminated surface. The photoelectric activity of a freshly polished metal surface diminishes with the time, falling off rapidly at first, more slowly later on. This is known as the "fatigue" of the Hallwachs effect. In the early literature of the subject the fatigue was attributed to the direct action of the light, but Hallwachs showed in 1904 that fatigue proceeds in complete darkness, so that light cannot be the primary cause of the change. This result has been questioned, but is now confirmed by the experiments of Bergwitz, Dember, Ullmann, and Allen. Light can, however, set up secondary actions tending to accelerate or retard fatigue.

Hallwachs has shown that at ordinary pressures fatigue is more rapid in a large vessel than in a small one. This also was called in question by Aigner, but is confirmed by Ullmann and by Allen.

The fatigue is practically independent of the electrical condition of the plate. This was shown by *v.* Schweidler, and has received confirmation in the researches of Hallwachs, Sadzewicz, and Allen.

Experiments in a vacuum have led to contradictory results. Lenard and Ladenburg found marked fatigue in certain cases, while for the alkali metals, first investigated by Elster and Geitel, several observers conclude that there is no true fatigue. Recent experiments by Millikan and Winchester show no fatigue with clean, unpolished metal surfaces in a very high vacuum. To explain the fatigue found by other investigators, we must take into account the mode of preparation of the surface (Ladenburg's plates were polished with emery and oil), the difficulty of removing air films from the surface, and the possibility of changes in the gas pressure.

Various theories have been advanced as to the nature of the change accompanying photoelectric fatigue:

(1) A chemical change, such as oxidation of the surface.

(2) A physical change of the metal itself, as, for example, a roughening of the surface.

(3) An electrical change in the formation of an electrical double layer (Lenard).

(4) A disintegration of the metal, due to the expulsion of electrons by light (Ramsay and Spencer).

(5) A change in the surface film of gas or in the gas occluded in the metal (Hallwachs).

Hallwachs has shown from the photoelectric behaviour of copper and its oxides, that oxidation cannot be the cause of fatigue, and the fact that fatigue is less in a small vessel may be interpreted by attributing it to some substance (*e.g.*, ozone, water vapour) present in small quantities in the surrounding atmosphere. The results recorded lead to the view that the main cause of fatigue is to be found in the condition of the gaseous layer at the surface of the plate.

Production of High Tension Discharges.

Professor Ernest Wilson and Mr. W. H. Wilson described a new method of producing high tension discharges and apparatus, whereby energy is taken from an alternating or continuous current source and stored in a magnetic field by an inductance; it is then permitted to surge into a condenser, which forms with the inductance a *low* frequency oscillatory circuit. When the energy is accumulated in the condenser, the latter is mechanically bridged across the primary winding of an induction coil, with which it forms a *high* frequency oscillatory circuit. The energy is then transmitted by the secondary winding of the induction coil to the work circuit, and can be of an oscillatory or unidirectional character according to the purpose in view. The apparatus is light, efficient, and cheap, and is especially suitable for radio-telegraphy, x-ray, and other work in which high tension electricity is employed.

Practical Standards of Electrical Measurements.

In the course of the report of the Committee on Experiments for Improving the Construction of Practical Standards for Electrical Measurements, we are told that in January, 1910, the Board of Trade took action in accordance with the recommendations of the report, and an Order in Council relating to electrical units, dated January 10, which contains definitions of the English standards of resistance, current, and electromotive force in conformity with the definitions adopted by the Congress, has been issued. This is printed as an appendix.

In accordance with a scheme approved by the International Scientific Committee appointed by Lord Rayleigh at the London Conference, international co-operative work on electric standards has this year been carried out at the Bureau of Standards, Washington. It was arranged that representatives of the Bureau of Standards, the Laboratoire Central d'Electricité, Paris, the Physikalisch-Technische Reichsanstalt, Berlin, and of the National Physical Laboratory should take part in the work. The representatives of the Bureau of Standards were Professor E. B. Rosa and Dr. F. A. Wolff, and the European delegates were Professor W. Jaeger, Professor F. Laporte, and Mr. F. E. Smith.

Professor S. W. Stratton kindly offered the facilities of the Bureau of Standards for the investigation, and, in his capacity as Treasurer of the International Committee, was able to secure the funds to defray expenses. Towards this object the governing bodies of the American Institute of Electrical Engineers, the National Electric Light Association, the Association of Edison Illuminating Companies, and the Illuminating Engineering Society, most generously subscribed £100 each. Some smaller contributions were also received.

The primary object of the meeting was to determine the electromotive force of the Weston normal cell in terms of the international units of resistance and current. At the same time it was necessary to clear up certain outstanding problems on the standard cell and the silver voltameter. Previous to the meeting, a great deal of experimental work had been done at each of the four institutions, and the results obtained were compared before deciding on a programme of experimental work.

The European delegates took with them from their own laboratories a considerable quantity of apparatus and chemicals, together with standards of electromotive force, resistance and mass. The results of the meeting are very valuable, and a full report is in process of preparation.

Another careful research on the silver voltameter has been made during the year by Professor F. Laporte at the Laboratoire Central d'Electricité. Professor Laporte shows that the result obtained in 1908 by Professors Janet, de la Gorce, and himself, is subject to an appreciable error, owing to the use of silver nitrate, now known to be impure. With carefully prepared nitrate, and using the Rayleigh form of voltameter, he obtains 1·11829 milligram per coulcomb for the electro-chemical equivalent of silver, the current being measured in terms of the Weston cell as 1·01830 volts at 17° C. and the international ohm as realised at the National Physical Laboratory. The unit of current was, therefore, the same as that used by Smith, Mather and Lowry in 1908, and the value for the electro-chemical equivalent found by Professor Laporte is in very close agreement with the value 1·11827 obtained by the British investigators.

The General Committee at Winnipeg accepted the recommendation of the Council and the Committee of Section A in favour of the re-publication of all the reports of the Electrical Standards Committee. Suitable arrangements for the work have, therefore, been made, and the material is now with the printer, but in consequence of the absence of Mr. F. E. Smith in America, and the work of preparation required for this, progress has necessarily been slow.

With regard to progress in electrical standardising work at the National Physical Laboratory, the Lorenz apparatus is practically complete, and some preliminary electrical measurements will, it is hoped, be made in October of the present year.

The Ayrton-Jones current balance continues to work most satisfactorily; small and gradual changes in e.m.f. of Weston cells, amounting to less than three parts in 100,000, have been detected by its aid.

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The results of the investigation on cadmium amalgams at the National Physical Laboratory were incorporated in a paper read before the Physical Society last February. It may be useful to give here the limits of temperature between which various amalgams may be most usefully employed in the Weston normal cell :—

Percentage of cadmium in the amalgam.	Lower limit.	Upper limit.
6	below 0° C.	about 27·7° C.
7	„	„ 34·6
8	„	„ 41·0
9	„	„ 46·0
10	„	„ 51·0
11	about 0° C.	„ 56·0
12	„ 8·7° C.	„ 60·0
12½	„ 12·1	above 60·0
13	„ 16.1	„ 60·0
14	„ 24·0	„ 60·0
15	„ 32·5	„ 60·0

The degree of reproducibility which is now obtainable with the Weston cell far surpasses what it was five years ago. At the National Physical Laboratory 67 cells were tested in 1909, and of these 60 agreed with the laboratory standards within one part in ten thousand. What is not understood at present is the occurrence of strange hysteresis effects in a few cells. The e.m.f. of such cells may be normal at first, but changes comparatively rapidly with time. Indeed, a large hysteresis effect in a cell appears to be an indication that the e.m.f. will not remain constant with time, whereas its absence is in general an indication of constancy.

In view of the fact that the re-publication of the reports is not yet completed, the committee has been re-appointed, with Lord Rayleigh as chairman, and Dr. R. T. Glazebrook, secretary.

Electrical Phenomena of Radium.

Messrs. W. Makower, S. Russ, and E. J. Evans have carried the investigations of radium several steps further, in determining the recoil of Radium B from Radium A. The first experiments by Russ and Makower were made to determine whether RaB is electrically charged when it recoils in vacuo from RaA, and, if so, the sign and magnitude of the deflection. A number of experiments, in which the RaB was passed through a strong electric field maintained between two brass electrodes made it clear that RaB is positively charged in these circumstances. Further experiments were therefore made, in which RaB recoiling in vacuo from a wire coated with RaA was caused to pass between two brass plates, 1·17 mm. apart, kept at a difference of potential which varied in different experiments from about 1,000 volts to 2,000 volts. The RaB subsequently fell upon a brass strip. After an exposure of 10 minutes to the radiation, the brass strip was removed, and the distribution of activity over the strip was tested by mounting it on a movable platform and bringing successive portions of the strip under a rectangular window made of aluminium leaf cut in a sheet of lead forming the base of an *a*-ray electroscope. The window was 3 mm. long and 1 mm. wide. The magnitude of the deflection thus found was of the order of magnitude to be expected if RaB carries the atomic charge of electricity and if its atomic weight is 214, as is to be expected on the transformation theory of radio-active processes.

Experiments were also made by Makower and Evans on the magnetic deflection of RaB when it recoils. The radiant matter was made to pass in vacuo through the field of a powerful electromagnet, and then to fall upon a brass strip as in the experiments on the electric deflection. The distribution of activity over the strip was measured, and the magnitude of the deflection produced by the magnetic field thus determined.

By measuring the radius of curvature of the radiation in a magnetic field of known strength, the value

$$\frac{mv}{e} = 7{\cdot}26 \times 10^5$$

was obtained.

In later experiments the RaB recoiling from a platinum wire coated with RaA was allowed to pass, in a magnetic field, through a slit, and then fall upon a brass strip for three minutes. The magnetic field was then reversed and the radiation allowed to continue for seven minutes, until the RaA on the wire had decayed to an inappreciable quantity. The brass strip was then removed and placed on a photographic plate and left for several hours. The RaC formed *in situ* from the RaB on the strip produced an impression on the photographic plate when developed. It was found that there were two well-marked maxima of intensity, representing the distribution of RaB reaching the strip with the direct and reversed magnetic fields. By measuring the distance between these maxima, and from the known dimensions of the apparatus, the radius of curvature of the rays in a magnetic field of know strength was determined, giving the value

$$\frac{mv}{e} = 6{\cdot}52 \times 10^5$$

This value is in fair agreement with that obtained by the first method, and is probably somewhat more accurate.

The value of $\frac{mv}{e}$ for the *a* particle from RaA has been found by Rutherford to be $3{\cdot}4 \times 10^5$. Now, since, the momentum of the *a* particle and that of the recoiling atom must be the same, it follows from these numbers that RaB carries the atomic charge of electricity, since the *a* particle carries twice that charge.

Taken in conjunction with the results of the experiments on the electrostatic deflection, the velocity of the radium B particles is found to be $3{\cdot}23 \times 10^7$ cm. per second, and its atomic weight 194.

Cyclical Charges in a Gas Engine Cylinder.

Professor E. G. Coker described a new method of carrying on experiments to determine the cyclical charges of temperature in a gas-engine cylinder near the walls. He referred to experiments described in "Engineering" for October, 1908, which showed that the temperature at the inner surface of a small gas-engine is about 240° C., and the cyclical variation is usually less than 10° C.

The steady conditions of low temperature at the wall surface are maintained by the jacket-water, although the explosion of the gaseous mixture produces very great changes of temperature close to the walls.

This variation had not hitherto been measured for a complete cycle owing to the difficulties which occur in measuring the highest temperature of the explosion. In order to obtain the cyclical variation near the walls, a couple was made of an alloy of 10% iridium and platinum, with a pure platinum wire, and this was secured in a metal plug so that it projected quarter-inch into the cylinder. On light loads and weak mixtures the cycle remained unbroken, but near full load the platinum wire melted.

Couples made from 10% alloys of iridium and rhodium with platinum were afterwards used, having an electromotive force E above 500° C. given by

$$E = -174 + 7{\cdot}6075\ T - 0{\cdot}00167\ T^2,$$

where T is the temperature centigrade. The junctions were rolled down to five or six ten-thousandths of an inch thickness and inserted at a depth of half-inch from the cylinder-wall. These couples were able to withstand the highest temperatures near the walls, and they were not melted except during abnormal explosions. Measurements of the cyclical variations showed a variation of E.M.F. lying between 1·56 and 7·83 milli-volts, with an average cold junction temperature of 30° C. The temperature variation corresponding to these values ranges between 250° C. and 1,700° C. In estimating the highest temperature reached, the upper limit of temperature is indicated by the partial melting of one of the wires when the engine ran above its full normal load, and the lower limit is indicated by the melting of platinum wire. The melting-point of platinum is 1710 ± 5° C., and, in the absence of definite values of the melting-points of the alloys used, it is assumed that both are below the melting-point of iridium, for which Viole's value is 1,950° C. The probable causes of error in the measurements were discussed, and the conclusion reached that the temperatures at the place of measurement has a maximum value between 1,850° and 1,900° C.

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The Third Report of the Committee, on Gaseous Explosions, presented at the meeting, is full of interesting information, containing much that has a direct bearing on the designing and running of internal combustion engines.

Positive Electricity.

Sir J. J. Thomson, in dealing with "Positive Electricity," said his remarks would be a continuation of the results announced by him last year at Winnipeg. Simplification could be effected in the observation of positive rays by the use of very large discharge tubes, of which he described the construction and manipulation. He indicated how with these tubes, supplemented with a phosphorescent screen, several types of positive rays could be observed. The first were rays not deflected either by magnetic or electrostatic forces. By these, secondary rays were produced which could be deflected by both electric and magnetic forces and had a constant velocity independent of the potential difference between the terminals. The third and most interesting type of rays were those which were characteristic of the gas from which they were produced. These were conspicuous only at low pressures, their velocity depending on the potential difference between the electrodes. These rays, he thought, were charged atoms of the gas, though in the case of hydrogen there seemed to be rays corresponding to the molecule as well as the atom. He showed that the different atoms of the more slowly moving rays could be spread out into a row of bright spots comparable with the spectrum, and he pointed out that as exceedingly minute quantities of gas might be dealt with in this way, it had appeared probable that interesting results might follow from the application of this method of analysis to gases in vacuum tubes. A fourth type of rays which travelled in the direction of the cathode rays and of the first and second types had also been discovered.

In the discussion, Sir Oliver Lodge questioned whether the spot on the screen supposed to be caused by the hydrogen molecule was not due rather to helium.

Sir J. J. Thomson pointed out the existence of a separate spot for helium when that element was present.

Sir Oliver Lodge then asked whether the second type of rays were positive electrons, and Sir J. J. Thomson expressed his opinion that they were so, on the ground that they could not be influenced by external conditions of pressure or differences of potential difference.

Price of Electricity.

Mr. Edward W. Cowan criticised principles adopted by the electrical industry as a basis for the charges made for electricity supply. A fundamental principle which the industry had established was that of charging upon the basis of equal rate of profit from every class of consumer. This system failed in the attainment of the best economic results, because the factor of demand was ignored in such a system. The demand for electricity was of a composite character. It was a demand for light, for power, for heat, etc. The intensity of demand as between these various uses of electricity would be different; that for light generally being greater than that for power, at a given price, and so on. Adjustment of price of supply according to the intensity of demand in the case of each class would secure a more efficient correspondence, and, consequently, a greater aggregate economic advantage. The difficulties in giving effect to a practical system of classified tariffs were discussed, and it was shown by reference to the successful operation of the system in railway working and in other industries that these difficulties were not insurmountable. It was also shown that electricity production for public supply was of the nature of a joint production, and it was argued that, in so far as it was of that character, no separate part of the supply could be regarded as having a separate calculable cost. The author contended that classification might be resorted to without any injury or loss to any class. The gain due to such a method was not a differential gain, but a specific gain which might be shared by all classes of consumers. Though the economy might not be great, small price changes sometimes effected great alterations in the volume and channels of trade.

Mr. S. L. Pearce, engineer of the Manchester Corporation, argued there were great difficulties in the adjustment of a scientific tariff, and the distribution of capital charges among different classes of consumers. Something might be done in the way of remission on capital charges to any new class of consumer to induce them to come on to the mains.

Mr. W. B. Woodhouse, of the Yorkshire Electric Power Company, said he would be in agreement with Mr. Cowan provided that the superior limit of price was not taken to be what the article would fetch. There should not be hard and fast lines in the prices of electricity according to the use to which it was put—whether light, power, or heat. No public supply authority was justified in making an extortionate profit out of any one class of consumers.

Mr. Watson, engineer of the Bury Corporation, held that the cost basis had on the whole proved the soundest in fixing the prices.

Professor Ashley said the principle of differentiation to which Mr. Pearce objected had been settled more or less satisfactorily by the railway companies.

Molecular Weight of Radium Emanations.

Mr. R. W. Gray read a paper contributed by Sir William Ramsay, F.R.S., and himself. He explained that according to the disintegration theory of radio-active change a definite number of radium atoms broke up per second, each evolving an A particle which ultimately became helium, and leaving behind lighter molecules which formed the gas known as radium emanation. Considering the different conditions under which the experiments were made, the writers of the paper considered that their experiments incontestably proved that the molecular weight of radium emanation approximated closely to the mean value, namely, 221.

That was to say, these results confirmed the correctness of the theory of atomic disintegration, and proved that no heavier particles accompanied the A particles on their expulsion at the moment of disruption of the radium atom. The most exact value, therefore, for the atomic or molecular weight of radium emanation was that deducted by means of the disintegration theory, namely, 222·5.

The fact was emphasised that the radium emanation was in every respect a true chemical element. Most of its physical properties had been determined. Its spectrum was first described by Ramsay and Collie, and more accurately mapped by Cameron and Ramsay, by Rutherford and Royds, and by Watson. The boiling point was first determined by Rutherford in 1908; and in 1909 Ramsay and Gray measured the critical pressure, critical temperature, and vapour pressures of the gas. From those measurements Rudolf had calculated the latent heat of evaporation of the liquefied emanation, and from a careful analysis of the vapour pressure curve had shown how closely the curve of emanation resembled those of Argon, Krypton, and Xenon. The melting point of the solid emanation had been approximately determined, and also the density of the liquid.

In chemical behaviour, the emanation was absolutely inert. In fact, all its properties proved that that element belonged to the inactive series of gases, and its atomic weight of 222·5, which the experiments confirmed, showed that it fell into the Argon series in the periodic table, and filled the second vacant space below Xenon.

"There is no longer any reason," concluded the paper, "why this element should not have a name which expresses its chemical relationships, and we therefore propose that it should be called 'Niton' (shining), and that its chemical symbol should be Nt."

Sir J. J. Thomson, referring to the proposed name, said it should have the concurrence of people not only in England, but all over the world. He did not think any attempt of a private individual to give a name would have any chance of success. He suggested that it should be left to the forthcoming congress on radiology at Brussels.

Effect of "X-Rays."

Dr. Dawson Turner, in his paper on the effects of "X-rays" in therapeutic doses on the growing brains of rabbits, remarked that the subject was of great importance, as a full dose of "X-rays" was frequently administered to children suffering from ringworms. Experiments by Recamier and others had shown that the "X-rays" interfered with the growth of the bones and teeth. Experiments had been performed by the speaker and Dr. T. G. George on young rabbits. One-half of the head was exposed to and one-half protected from an ordinary "X-ray" dose.

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This dose was repeated three times with an interval of a week between each dose. Of six rabbits chosen for the experiments, only one survived for examination, so that no corroboration could be obtained of the changes observed. The microscopic changes in the brain were slight and inconclusive, but there were some undeniable gross changes, *e.g.*, the left or unexposed half of the brain was decidedly larger than the right or exposed half; the iris first on the left and then on the right side had undergone fatty degeneration: all the animals had lost weight during the exposures. It would, therefore, seem highly desirable that further investigation of this subject should be made, and that caution should be exercised in the administration of the "X-rays" to the heads of young children in whom the skull bones were not properly ossified. Nor should such treatment be adopted without the parent's full consent.

Electrons and Atoms.

Dr. J. A. Crowther, Cambridge, read a paper on "The Number of Electrons in the Atom." Having shown that the electron was a fundamental part of matter, and must be contained in the atom of every element, he described experiments whose object was to analyse, so to speak, the atom, and to determine how many of these minute particles or electrons it contained. To do this it was necessary to use something capable of penetrating into the atom, and such a tool was found in the "B" rays from radium, which were simply negative electrons, but moved with such immense rapidity that they could pass through considerable thicknesses of solid materials. These rapidly-moving electrons penetrated the atom, and, coming into collision with the electrons already there, were deflected from their original path. Every new collision they made caused a new deflection; and by measuring the total amount of the deflection suffered by the B particle in its passage through a sheet of material, it was possible to calculate the number of collisions it had made. In this way we could discover how many electrons there were in any given atom. It was found, said Dr. Crowther, that the hydrogen atom, which was the lightest known atom, contained just three of these electrons. The number contained in heavier atoms was proportionately greater. The analysis of the atom by means of the "B" rays from radium had also thrown new light on the question of the nature of positive electricity.

Accelerometer, Road Resistance and Horse Power.

Mr. H. E. Wimperis, A.M.Inst.C.E., in touching on the use of an accelerometer in the measurement of road resistance and horse power, described the form of accelerometer recently invented by him and constructed by Messrs. Elliott Bros. The instrument consists of a brass box about 4 inches across, containing a copper disc mounted on a vertical pivot and "damped" in its motions by a permanent magnet. The c.g. of the disc is purposely removed from the axis so that when the box moves forward, one side of the disc tends to lag behind, thus partially winding up a coiled spring and actuating a pointer which moves over a scale. To render the reading unaffected by an accelerations at right angles to the direction of motion, a second parallel axis is fitted, which is geared to the first one, and has attached to it masses having the same mass moment as the disc itself. Couples about these two axes add up in the direction of motion, but neutralise one another in any direction at right angles. The accelerometer, therefore, reads in one of the three directions of space only, and is not affected by even violent movements in the other two directions. With this instrument the author has measured the road resistance of various classes of road, and has obtained figures varying from 50 to 210 lb. per ton. On main line railways the resistance is usually from 12 to 30 lb. per ton, depending on the speed. Measurements have also been made of the resistance to motion when a motor car is coasting. In this way the horse power and the engine friction can be measured and a figure for the mechanical efficiency be obtained. The conclusions reached may be summed up as follows: By the use of the accelerometer road resistances can be read off at sight; the air resistance of various shapes of car body can be determined; the b.h.p. and i.h.p. of the engine can be obtained for various speeds; and that it is possible to trace step by step the losses of power in transmission to the road wheels.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

ANSWERS.

Question No. 1224.—What is the principle of the new tube lighting now being tried at the Bradford Town Hall? What is its efficiency compared with metal or carbon lamps? Can wool be sorted and patterns matched properly with this light? If the voltage be 2,000, what will the Board of Trade say to that in the ordinary sorting room of a factory? Are there interlocking and earthing devices on the market to ensure safety for such as a Mill Electrician?

Reply to Question No. 1224 (*awarded* 10s.).—The Moore lamp is, so far, the only practical application of the vacuum, or Geissler, tube as a source of illumination. The low intrinsic brilliancy of the source, less than that of any other practical illuminant, makes necessary a very large luminous area, The lamp being in the form of a tube (usually some $1\frac{3}{4}$ in. diameter), this requirement involves the use of a very long tube and hence, the electrodes being separated by a vacuum of about 0·1 mm. mercury, a very high terminal p.d. is necessary. The length of tube employed rises to 150–200 ft. or more, and the terminal p.d. to

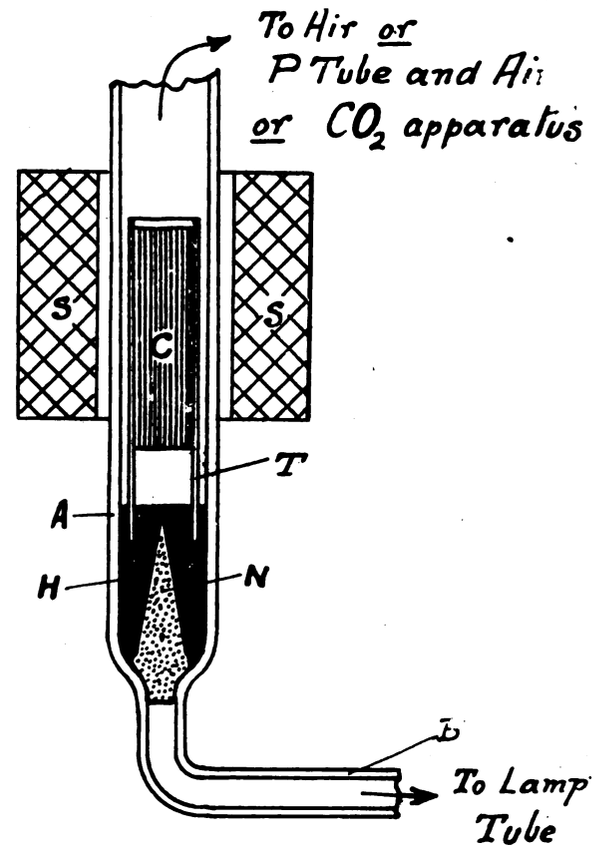

Fig. 1.

10,000 or 12,000 volts: the current passing through the lamp is about $\frac{1}{3}$ amp. in such cases. Alternating current is imperative; a 200 v. 50 ~ or 60 ~ supply is connected to the primary of an air cooled transformer and stepped up to the required secondary voltage; the transformer and the secondary connections to the lamp tube are contained within a locked or sealed chamber. Only low tension leads enter and leave the latter, and should the lamp tube be broken the high tension discharge immediately ceases, so that there is no danger in using the lamp, in spite of the enormous secondary voltage dealt with.

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The lamp tube must clearly be built up and exhausted *in situ*, an advantage inasmuch as every lamp can thus be best suited to the circumstances of the space lighted. The tube is usually carried in a cornice or against the ceiling by brass rings spaced at suitable intervals. The two ends of the tube are brought together in the connecting chamber as above and are provided with graphite electrodes connected to the transformer secondary through platinum leads sealed through the tube. The Moore lamp is self-lighting, a considerable advantage over the mercury vapour lamp, and a particularly fortunate fact in view of the great size of the lamp (which would render any "striking" devices impracticable).

ACTION.—As the lamp burns, the residual gas in the tube is absorbed and the vacuum increases, i.e., the tube becomes "hard." This leads, at first, to an increase in conductivity, but, ultimately, the conductivity decreases rapidly and the lamp would be extinguished (see Fig. 2) were there no means available for restoring the vacuum to its initial value. This hardening effect would make the operation of a Moore tube unsatisfactory within a few minutes if not corrected, hence the whole success of the lamp depends on the ingenious "breathing" device sketched in Fig. 1. A small side tube *B*, sealed into the

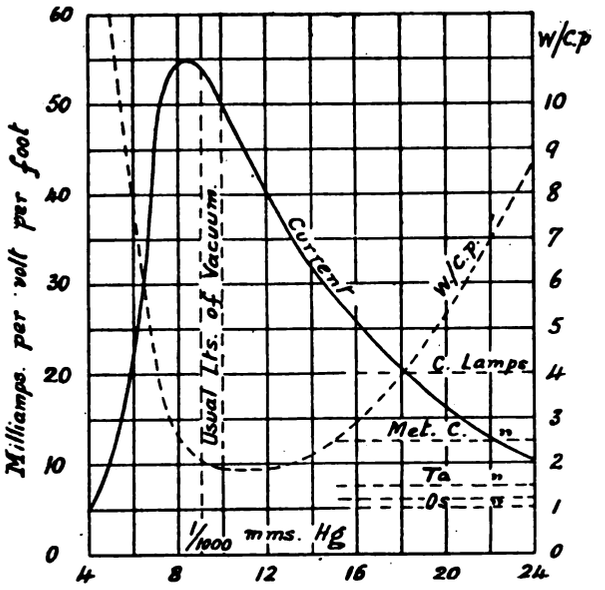

FIG. 2.

main lamp tube, terminates in a wider vertical tube *A* leading to the air, nitrogen or carbon-di-oxide supply as shown. The bottom of *A* is sealed by a carbon plug *N* surrounded by so much mercury *H* that, when the tube *T*, carrying the soft iron core *C*, is in its lowest position, the tip of *N* is just covered. The solenoid *S*, surrounding *C* is in series with the primary of the lamp transformer. As the vacuum "hardens" the current through the lamp, and therefore through *S*, rises: hence *C* and *T* rise and the level of *H* falls, exposing the tip of *N* and allowing gas to percolate into the lamp till the current becomes normal again and *T* falls. The softening of the vacuum thus made possible occurs about once a minute, its frequent occurrence and gradual action preventing any noticeable light fluctuations. The reason for choosing 0·1 mm. vacuum as the normal exhaustion (falling to 0·09 mm. when "breathing" is imminent) is that the efficiency is then nearly a maximum (see Fig. 2—McFarlane Moore's data) and the current characteristic is then such as to enable good, stable regulation.

COLOUR.—The colour of the light emitted by the Moore lamp depends, as in all Geissler tubes, on the gas used within the tube. Nitrogen appears to give maximum efficiency, but yields a rosy yellow light: the latter gives a warm appearance to interiors and is often permissible. If nitrogen be used, the lamp draws in air, when "breathing," over phosphorus which absorbs oxygen and dries the gas. Using air, a whiter light of lower efficiency is obtained; though carbon-di-oxide yields only about one half the efficiency obtainable from nitrogen, it is often used for the sake of the white light emitted. CO_2 is then supplied to the breathing valve from hydrochloric acid acting on marble.

Tests made recently by H. E. Ives* concerning the colour value of Moore lamp rays showed that the CO_2 lamp yields a white light with the same proportions of blue to red as are found in daylight received from some part of a clear sky between the horizon and the zenith: the exact altitude depends on atmospheric conditions, but is generally nearer to the horizon than to the zenith. Owing to the variable quality of daylight no more precise statement than this can be made.

EFFICIENCY.—Owing to the diffused nature and large area of the luminous source it is difficult to accurately determine its C.P. The efficiency varies with the gas employed, but, in nitrogen tubes, = 1·6 to 1·75 or 1·95 watts per c.p. (the voltage of supply does not greatly affect this efficiency). It is obvious that the Moore lamp effects no startling increase in efficiency, indeed many English engineers doubt the financial economy of this lamp, though American and German authorities appear more optimistic in this respect. The low intrinsic brilliancy of the source and the pleasant, diffused and steady nature of its light compensate for the rather disappointing efficiency.

RENEWALS.—The lamp tube itself does not sensibly deteriorate; its life is limited only by accidental fracture. It is necessary to renew the phosphorus in the nitrogen tubes at intervals of 1 or 2 years, and it is well to then overhaul the whole lamp, renewing the carbon valve if necessary and, possibly, blowing through the main tube and re-exhausting.

The Moore vapour lamp is the nearest commercial approach to a "cold" light that has yet been attained. The lamp has been greatly improved since its first introduction, and will probably be considerably used in future in courtyards, large halls, etc. A 176 ft. tube has been in operation for some two years in the courtyard of the Savoy Hotel, London; numerous installations are at work in the U.S.A., and experimental equipments are reported in Berlin and Moscow. The Bradford lamp is the second English installation of magnitude.—"WREN."

WORKS AND TECHNICAL PHOTOS.

A correspondent writes: "Can you tell me what apparatus, camera, etc., is necessary for taking good photos of workshops, specially interesting machinery, etc.? Also, can you give me some hints on preparation of subject and arrangement of camera, and on lighting and exposure? Does the vibration of the shop and machines often effect matters? How are semi-transparent (or ghost) photos of machines taken? When is distortion serious, and what is its remedy?"

In reply, we may say that no special camera is required for photographing shop interiors and machinery. Any good square landscape camera will do. It should be a rigid pattern, with reversing back rising front, and other usual adjustments. It is important that there should be great range of extension, as it is necessary to use both long and short focus lenses in such work, according to the difficulties of the situation.

The tripod should be of a very strong and rigid pattern, and have sliding joints, so as to adjust for any desired height. A good modern anastigmat lens should be employed. It is possible to get lenses which will give varying foci, by using either the back or front lens separately, and also having interchangeable lenses for screwing into the same tube.

A portable background is required when photographing machinery. Bright parts should be dabbed over with putty to dull them. In dark situations it is necessary to have a flash lamp for lighting. Plates of medium rapidity are used as a rule. When the photos have been made, it is usual to retouch them with the aerograph, which is a device for spraying black or white water colour on parts that require improving in the light and shade, or where parts not wanted have to be removed. In this way "ghost" photographs are produced. This part of the work is usually done by the engraver.

Messrs. A. W. Penrose & Company, Ltd., of 109, Farringdon-road, E.C., will be able to supply all requirements for such work as you require.

* Bureau of Standards, Washington: see "Electrical Review and Western Electrician."

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THE
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IMPORTANT NOTICE TO ADVERTISERS.

Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements 24 words 1s per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

Situations Vacant, 24 words 1s., three insertions 2s. 6d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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SOUTH AMERICA.

An era of peace seems to have settled down on the larger and wealthier republics of South America, and coincident with this we find considerable increase of population and energetic commercial development. Taking the sub-Continent as a whole it is a land of great stretches of country seamed with high mountain ranges and big rivers. These big rivers present enormous power, mostly running to waste, but both the inhabitants and foreign dwellers have already succeeded in harnessing the waters of many of these rivers, mostly to convert their force into electricity for the lighting of the larger coastal and inland towns, the providing of power for tramways and railways and for manufacturing purposes. With the commercial activity already referred to the rivers are being more and more looked to as sources of hydro-electric power. Apart from this, however, and here we have a most promising sign of the genuine development pointing to future greatness and stability, in many places steam generating electricity stations are being erected. Our news columns constantly contain notes of such new departures. We can point to the quite recent instances of the Lemousin concession at La Plata, the Paquet and Company's concession at Riachudo, the Cordoba concession, that of McDermot at Antofagasta, and of Uruchurto at Santiago, besides several others which are dealt with in our news columns this week. Moreover, we see that the existing undertakings are one after another taking steps to enlarge their plant, the demand upon their output steadily increasing; some of them, too, find it wise and profitable to extend their field of exploitation, not infrequently even to take up fresh concessions at a distance from their headquarters. It is manifest, therefore, that South America is a rapidly developing market—so far as the demand for electrical machinery and appliances is concerned. We may ask ourselves whether British engineers and manufacturers are doing all that they might to not only extend their influence, but to maintain their footing. It is curious enough

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that our keenest competitors in these regions are not men from the United States, a land where electrical industries are so splendidly equipped, but from Germany chiefly, and from Belgium, which latter often means the introduction of plant either from Switzerland or Germany. In looking into matters we are struck with two influences at work: the Germans and Belgians are eager to search out openings and willing to take any trouble to push business, while ample capital is always available to back any enterprise. It is only comparatively recently that we were startled by the capture of the Rosario electrical undertaking from us by the Belgians, just at a point when extensions were becoming both feasible and urgently demanded. Now it is not astonishing to learn that the electrical plant being introduced is of German manufacture, and no doubt this will be followed by increased imports of electrical appliances for consumers from Germany. This transaction was a very genuine loss to British electrical industry. In a review of the situation in Argentina "The Times" says: "While there has been a remarkable development during recent years in the utilisation of electricity both for lighting and traction requirements, there is in the Argentine Republic at the present time no native industry in connection with the manufacture of electrical materials, the whole of the plant employed being imported from Europe and the United States. To Great Britain belongs the credit of having initiated the electrical industry, but this excellent beginning was not maintained, and to-day the greater part of the business is in the hands of German firms. A striking example is furnished by Buenos Aires, where, in spite of the fact that the vast tramway undertaking in that city was started by British enterprise and was for many years owned solely by British capital, the supply of electric current both for lighting and traction is the monopoly of the German Transatlantic Electric Company. The great call made upon the power house for current for traction purposes may be gauged from the fact that the tramway system of Buenos Aires runs 22,000,000 car miles per annum. The German power company is at the present time erecting a large new generating station of 120,000 h.p. capacity, which is to be opened in sections as completed." Our contemporary goes on to refer to developments elsewhere in the Republic: at Bahia Blanca, at La Plata, Cordoba, Rosario, and so on. Now, what is true of Argentina is also true, perhaps in a lesser degree for the present, but with greater prospects for the future, in other countries of South America. In Brazil, Chili, Peru, and elsewhere, we find our foreign friends extremely active either in seeking concessions, or backing up local concessionaires with the object of securing contracts for a supply of plant and equipment. Yet our reputation for enterprise, fair dealing, and the best grade of manufactures stands high in the whole sub-Continent; it is merely a matter of wise energy and bold financing for us to do more than maintain our position, and so reap the benefits that must accrue at no distant date in connection with electrical development in those vast and rich regions.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149. Fleet Street, London, E.C.

CONTRACTS.

LITTLEBOROUGH URBAN DISTRICT COUNCIL.

ELECTRICITY SUPPLY.

The above Council are prepared to RECEIVE TENDERS for the SUPPLY and DELIVERY of ALTERNATING CURRENT (single and three-phase) ELECTRICITY METERS.

Copies of the specification, with conditions and form of tender, may be obtained from the undersigned on depositing a cheque for two guineas, which sum will be returned when the contract has been awarded.

Specifications may be seen but not obtained at the office of Messrs. Hawtayne and Zeden, 9, Queen-street Place, E.C., London, consulting engineers to the Council.

Tenders, sealed and marked "Tenders for Electricity Meters," must be addressed to the undersigned, at the Council Offices, Littleborough, near Manchester, and to be delivered to him there on or before Tuesday, September 13, 1910.

GEORGE H. WILD,
Clerk to the Council.

Littleborough,
August 22, 1910.

MANCHESTER CORPORATION WATERWORKS.

TENDER FOR ELECTRIC CRANE.

The WATERWORKS COMMITTEE INVITE TENDERS for the SUPPLY and DELIVERY at Longdendale of an ELECTRIC DERRICK CRANE.

Specification and form of tender may be obtained on application to the Secretary, Waterworks Offices, Town Hall, Manchester.

Sealed tenders must be delivered not later than the 12th instant.

By order,
THOMAS HUDSON,
Town Clerk.

Town Hall, Manchester,
September 2, 1910.

DURBAN CORPORATION.

ELECTRIC PLANT REQUIRED.

Sealed tenders, addressed to the undersigned will be received at the Town Clerk's Office, Durban, until 11 a.m. on Wednesday, September 28, 1910, when they will be publicly opened in the Council Chamber, for the supply of—

Elevated jet condenser and piping.
Switchboard.
Rotary Converters.
Cables.
Transformers.

Duplicate tenders for the above must be sent to the Corporation's London Agents, Messrs, Webster, Steel & Company, 5, East India-avenue, London, E.C., by the same date, viz., September 28.

Specifications and drawings may be obtained on application to the Borough Electrical Engineer's Office, Durban, on deposit of one guinea for each specification, to be returned on receipt of a bona fide tender.

The Council do not bind themselves to accept the lowest or any tender.

By order of the Mayor and Council.

WILLIAM COOLEY,
Town Clerk.

CONTRACTS OPEN.

HOME.

LITTLEBOROUGH.—The District Council invite tenders for the supply and delivery of alternating current (single and three-phase) meters. Particulars (42s.), from Messrs. Hawtayne & Zeden, 9, Queen-street-place, London, E.C. September 13.

LONDON.—The Powell Duffryn Steam Coal Company invite tenders for one year's supply of electrical goods. September 12.

LONDON, FOR DURBAN.—The Town Council of Durban invite tenders for the supply of elevated jet condenser and piping, switchboard, rotary converters, cables and transformers. Particulars from Messrs. Webster, Steel & Company, 5, East India-avenue, E.C., to whom tenders must be sent by September 28.

MANCHESTER.—The Corporation Waterworks Department invite tenders for the supply of an electric derrick crane. Particulars from the Secretary, Waterworks Office, Town Hall. September 12.

MOUNTAIN ASH.—Urban Council invite tenders for the supply of 12 months' electrical stores. Particulars from H. H. McLeod, Robert-street, Ynysybwl. September 12.

WARRINGTON.—The Guardians invite tenders for one year's supply of electrical goods. Particulars from Clerk. September 13.

PORTSMOUTH.—The Corporation Electricity Department invite tenders for the removal of ashes, etc., from the yard of the electric lighting station. Particulars from the Engineer and Manager. September 12.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc. required for the establishment of water supply and electric light systems in the town of Beni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage électrique à Béni-Souef—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministère de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

CALCUTTA.—The Calcutta Electric Supply Corporation, Ltd., invite tenders for the supply, delivery and erection at their Cossipore station and sub-stations, Calcutta, of the following: Specification No. 5, motor generators; Specification No. 6, turbo alternators and condensing plant. Particulars from Francis R. Reeves, secretary, the Calcutta Electric Supply Corporation, Ltd., Salisbury House, London-wall, E.C. September 19.

DURBAN.—The Corporation invite tenders for the supply of an elevated jet condenser and piping, switchboard, rotary converters, cables, and transformers. Tenders will be received up to September 28, at the offices of the Corporation, Durban, and

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PATENTS.

S. SOKAL, Chartered Patent Agent,
AND
Certified Austrian Patent Attorney (Patentanwalt), Specialist for German Patents and Patent Litigation.

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THE PROPRIETOR OF THE PATENT No. 175 308, dated 1907, for "Improvements in Electrical Ac mulators," is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to—

HASELTINE, LAKE & Co.,
Chartered Patent Agents and Consulting Engineers,
7 & 8, Southampton-buildings, Chancery-lane, London, W.C.

THE PROPRIETOR OF THE PATENT NO. 19979 of 1904 for "Improvements in Magnetic Wheels or Electro-magnetic Motors," is desirous of entering into arrangements by way of license and otherwise on reasonable terms, for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to—

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THE PROPRIETOR OF BRITISH PATENT No. 23172 of 1905, for "Improvements in or relating to Electro-Mechanical Systems for the Propulsion of Automobiles," is desirous of entering into arrangements with British manufacturers with a view to the granting of licences under the patent so far as the application of the system to traction on rails is concerned.

In this propulsion system a separate explosion motor and a dynamo, connected to a battery of accumulators, are provided for each driving wheel of the vehicle.

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HENRY SKERRETT,
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THE PROPRIETORS OF THE PATENT No. 4927, 1907, dated 1906, for "Improvements in or relating to Electric Furnaces," are desirous of entering into arrangements by way of license and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to:—

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7 & 8, Southampton Buildings, Chancery Lane, London, W.C.

THE OWNERS OF BRITISH PATENT No. 22113 of 1906, entitled "Improvements in Party Lines Telephone Systems," granted to The Select Telephone Manufacturing Company and W. M. Bruce, jr., are desirous of disposing of the patent or entering into a working arrangement under license with those likely to be interested in the same. In the alternative, the owners would be open to consider proposals to manufacture the invention to fill any requirements of the market in Great Britain on terms to be arranged. The patent covers an invention interesting to Telephone Companies, Contractors and Telephone Manufacturers, and deals with arrangements for securing secrecy in party line telephones.

Detailed information as to the invention will be found in the patent specification, of which a copy will be supplied to any interested party on request.

Full particulars can be obtained from, and offers made (for transmission to the owner) to—

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ELECTRICAL GRADUATE of an American University with 1½ year's practical training with the largest Electrica Company at present in America, desires position with some Technical Institution or in Electrical Laboratory. Can furnish excellent references both in England and America.—Address, Box N.Y., c/o THE ELECTRICAL ENGINEER.

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by the London agents to the Corporation, Messrs. Webster, Steel & Company, 5, East India avenue, Leadenhall-street, E.C. Copies of the specification can be obtained from the Electrical Engineer, Durban Corporation, Durban, on payemnt of one guinea.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels. September 26.

HOBART.—The Deputy Postmaster-General will receive tenders up to noon on October 17, for the supply of various telegraph and telephone material (Schedules Nos. 1—9), including cable, instruments, switchboards, battery material, wire, insulators, ironwork, &c. A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). Specifications, Direction des Chemins de Fer d'Outre-mer, Lisbon. October 12.

MELBOURNE.—The Deputy Postmaster-General, Melbourne, will receive tenders on October 4 for the supply of telegraph and telephone insulators (Schedule No. 332). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, as above.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on October 4, for the supply of telephone material (Schedule No. 363). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. A copy of the specification may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

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MELBOURNE.—The Deputy Postmaster-General invites tenders for: (2) Up to 3 p.m. on October 18, for the supply of 23 miles of telephone cable (Schedule No. 284); (3) Up to 3 p.m. on October 18, for the supply of 500 composition insulators (Schedule No. 374); (4) Up to 3p.m. on October 25, for the supply of 10,000 Cordeau insulators (Schedule No. 373). A deposit will be required with each tender. Local representation is necessary.

TACUAREMBÓ, URUGUAY.—The municipal authorities of Tacuarembó, invite tenders for the equipment of an electric generating station and the supply of electric light at San Fructuoso. Tenders will be received at the "Secretaría de la Intendencia Municipal de Tacuarembó," Tacuarembó, up to 2 p.m. on September 30.

TENDERS ACCEPTED.

HOME.

DUBLIN.—The South Dublin Union have accepted the tender for the electric light installation at the Workhouse of the A.E.G. Electrical Company (Manchester branch) at the sum of £2,357 4s., and £250 for maintenance for five years. The local tenders were £500 above the first-named sum.

KEIGHLEY.—The tender of Messrs. Babcock and Wilcox, Ltd., for the supply of a second water tube boiler, with superheaters, stokers and steam pipes, at a cost of £1,458, was accepted.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

IPSWICH: A criminal lunatic asylum is to be built near Retford at a cost of £130,000. A light railway will be constructed to connect the asylum with the Great Central line.

MARKET HARBOROUGH: S. P. Pick, architect, Millstone-lane, Leicester. Erection of Police-court, superintendent's house, stables, and alterations to existing buildings.

NEWCASTLE-ON-TYNE: L. H. Armour, 16, West-street, Gateshead. Picture theatre to be erected at Annfield Plain.

PENGE: H. W. Longdin, Town Hall, Anerley. Additions and alterations to offices at Town Hall.

PORTSMOUTH: Borough Engineer. Erection of waiting rooms for visitors and bicycle store, and additions to engineer's office at Town Hall.

SWANSEA: Education Offices, Grove-place. Training College for Women.

TEWKESBURY: H. A. Badham, school secretary. Alterations to old Grammar School.

WATFORD: Russell & Cooper, architects, 12, Gray's Inn-square, W.C.; Roper, contractor, Ipswich. Erection of Grammar School.

WELLINGTON: Shaylor, Swan and Ridge, architects, Pride-hill, Shrewsbury. Secondary School for 200 pupils.

WEST HAM: W. Jacques, architect, 2, Fen Court, Fenchurch-street, E.C. School at Canning Town for 1,500 children.

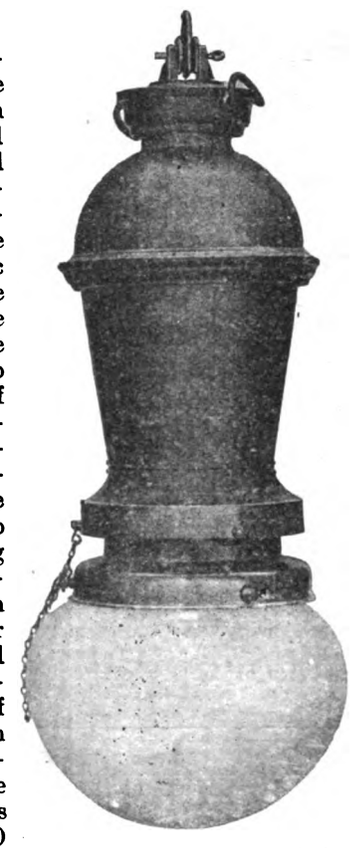
WEYBRIDGE: The Congregational community propose to erect a manse.

NOTES.

Burglar Alarm.

With the approach of long, dark nights, burglars will be getting to business again, and, consequently, it is well to suggest to householders that they should take adequate precautions. Among these must be included the provision of alarms. But it is essential that the alarm itself should be burglar proof, and this is just what the Adnil Electric Company, Ltd., claim for their electric alarm. It is a compact and simple appliance, the working of which depends upon the principle of the Wheatstone bridge. One of the four arms consists of an attachment fixed to the safe, strong room, or door to be protected. This attachment contains a resistance, and a special contact, the latter short-circuiting the resistance and so unbalancing the bridge the moment the protected point is meddled with. The current which flows through the alarm relay when the bridge is balanced causes the former to attract its armature and to set the bell going in the alarm case. The current is supplied by a permanent current battery through a battery checking relay, a device which secures the release of its armature and consequent ringing of a bell, when the main battery current becomes too weak. In addition, there is a bell battery to actuate the bell relay and alarm bells. It is claimed that the alarm acts: 1. When any wires connected to the main instrument are cut, tapped, bridged or short circuited; 2. When the pendant contact attached to the safe is tampered with or disconnected; 3. When the temperature in the neighbourhood of the apparatus rises above a certain limit. (To fulfil this requirement a fire alarm contact is fitted.); 4. When one of the alarm bells is disconnected or shunted; 5. When the battery is cut off or becomes exhausted; 6. When the visual checking signal (if this is provided), is disconnected; 7. When any electrical current from any external source is applied to any of the wires connected to the apparatus; 8. When a door, window or fire alarm contact, which may be attached to the apparatus, is operated.

Intensified Arc Lamps.



In the Intensified Enclosed Arc Lamp, the British Thomson-Houston Company have embodied the result of long continued research in the improvement of arc lamps. Carbons of small diameter are used, so that when the arc is formed not only the crater but the whole of the carbon tips become a source of light. In order to do away with the necessity of providing regulating mechanism for the upper carbon and to prolong effective life, the small positive carbons are brought into abutment, the arc being maintained at a predetermined position in relation to the reflector. The lower negative carbon is actuated by the lamp which regulates the arc. The whole of the mechanism is new in design and has been simplified to the utmost. The result is that these lamps will burn for from 50 to 60 hours with one set of carbons, the focussing of the arc being maintained, and a steady white light, quite sufficient for selecting and matching colours, is obtained. They are highly efficient and economical and handsome in appearance, as will be seen from the illustration. A special illustrated price list, No. 252, has been prepared for contractors.

People's Palace, Mile End Road.

The Foster Arc Lamp & Engineering Company's "Q" type flame lamp has been selected for the illumination of the People's Palace, Mile End Road, E., Messrs. H. J. Cash & Company, Ltd., of Caxton House, being the contractors. It may be mentioned that the company have recently been able to make sweeping reductions in the price of carbons for this lamp, which, no doubt, will add to the popularity of this already favourably known "Q" type. It is claimed for this flame lamp that it is the lowest in carbon cost per burning hour. We gave full particulars of it at the beginning of the year. Since then, we learn, Foster's have had a very large number of orders for it.

"Multax" Flame Lamp.

The Globe Electric Company, Ltd., have brought out in readiness for the winter season a most striking showcard. It shows up the "Multax" long-burning flame arc lamp in a glow of golden light, with an outer circle of black. The card is very effective for display purposes, and should be secured, together with price lists, by all contractors and supply companies.

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TECHNICAL CLASSES.

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There are two City and Guilds Colleges providing Courses of Instruction in Engineering and Chemistry. The **City and Guilds Central Technical College** (Exhibition Road), and the **City and Guilds Technical College, Finsbury** (Leonard Street, E.C.). The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

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Civil and Mechanical Engineering .. W. E. DALBY, M.A., B.Sc., M.Inst.C.E., (Dean for the Session).
Electrical Engineering .. .. T. MATHER, Wh. Sch., F.R.S.
Chemistry .. .. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics .. O. HENRICI, Ph.D., LL.D., F.R.S.

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Mechanical Engineering and Mathematics .. E. G. COKER, M.A., D.Sc. F.R.S.E., M.Inst.M.E.
Chemistry .. .. R. MELDOLA, F.R.S., F.I.C.

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ENTRANCE DAY FOR NEW STUDENTS, TUESDAY, OCTOBER 4.

HEADS OF DEPARTMENTS.

Engineering ..	Professor D. S. CAPPER, M.A., M.Inst.C.E. (Dean).
	Professor H. M. WAYNFORTH, M.I.M.E., A.M.Inst.C.E. (Sub-Dean).
	Professor M. CURRY, M.Inst.C.E.
Electrical Engineering	Professor E. WILSON, M.I.E.E.
Mathematics ..	Professor S. A. F. WHITE, M.A.
Chemistry ..	Professor J. M. THOMSON, F.R.S.
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The work of these Departments is carried on in separate blocks of buildings specially equipped for systematic instruction. Prospectus may be had free on application from the Registrar.

THE NEXT SESSION BEGINS ON OCTOBER 4th, 1910, on which day the ENTRANCE EXAMINATION will be held at 10 a.m. and 2 p.m.

University of Durham.

Armstrong College, Newcastle-upon-Tyne.

PRINCIPAL: W. H. HADOW, M.A., D.MUS.

SESSION 1910-11.
(*Commencing September 26th*, 1910).
Matriculation Examination, September 20th-23rd.

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CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—Principal J. W. WILSON, M.I.C.E., M.I.Mech.E. The New Course will commence on Wednesday, 14th September. New Students should attend at the School on the previous day between 10 a.m. and 1 p.m., for examination. Prospectus forwarded on application to the REGISTRAR, School of Engineering, Crystal Palace.

Standard Electrical Works.

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Chapel Lighting.

Messrs. Smith Bros., High-street, Rotherham, have carried out an extensive electrical lighting installation at the Masbro' Independent Chapel.

Storage Batteries.

The D. P. Battery Company, Ltd., of Bakewell, have just concluded contracts for the supply of their batteries to the District Councils of St. Annes-on-Sea and of Naas (Kildare), the Chorlton Board of Guardians, and for a number of private installations. The maintenance of these batteries for terms of years has been undertaken by the company. They have also secured orders for three batteries for South Africa for mining and other purposes. Specimen cells of their manufacture are being exhibited at the Buenos Ayres Exhibition by their agents, Messrs. Milne, Makein Y Cia., of that city. We learn that the company desire to appoint additional agencies in foreign countries where they are not already represented.

MINE SIGNAL WIRE.

Necessary Precautions During Repairs.

Mr. David Rees, coroner, held an inquest at Pencoed, last week, on John Jones, collier, who was killed by electricity at the South Rhondda Colliery. Mr. Robert Nelson, Electrical Inspector of Mines, sat with the Coroner on behalf of the Home Office.

Edward Jordan said he and the deceased were working on the night shift putting up iron girders on the main road in the Hafod seam. Deceased picked up a few yards of old loose signal wire which was lying on the side of the roadway to hand to witness. He had no sooner done so than he shouted "Oh," and fell down, apparently dead. Witness tried to take the wire from him, but was rendered unconscious for a few seconds by the shock.

John Matthews, fitter, said he was in charge of the electrical apparatus. He heard a scream and saw a flash of light. On running to the spot he saw John Jones lying on the ground with the wire in his hand. The wire extended across the roadway to the electric cable. Witness caught hold of the cable, using india-rubber gloves, and released it. He then tried artificial respiration, but Jones was dead.

Witness examined the cable and found that the signal wire, which Jones had picked up, was hitched into the cable, near the joint, and some of the insulating tape around the joint had got loose. Witness believed that the tape had been pulled loose by the piece of wire catching into it—that a sharp end of the wire had cut through the tape to the core of the cable, but he could not say for certain, as he repaired the cable as soon as possible without examining it further.

Mr. William Williams, manager, said he had notices posted up in the colliery about the electrical installation. At the spot where the accident occurred the cable was charged with from 300 to 400 volts continuous current.

Mr. Nelson, the Home Office expert, said he examined the cable generally. He concluded from the evidence that the shock was conveyed in some way from the piece of disused signal wire. Whenever repairs were being carried on, or girders erected, electrical cables should certainly be protected. Disused wires should always be removed, and not left on the roadway where there were electrical cables.

A verdict of "Accidental death" was returned.

The jury stated in a rider that they found that death was due to electric shock, but that there was not sufficient evidence to show whether the cable was defective at the point where the accident occurred. They were of the opinion that the recommendations of Mr. Robert Nelson should be strictly carried out at all collieries.

ELECTRICITY AND DENTISTRY.

At the International Dental Exhibition, now being held at the Royal Horticultural Hall, Westminster, a model surgery has been erected at a cost of £300, a maple switchboard with aluminium fittings practically controlling the whole furniture of the room. While the leverage of the operating chair is worked by an oil pump in place of water, a work cabinet fitted with an electric lathe enables the practitioner to perform all the necessary mechanical work without leaving the surgery.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS, SOUTH WALES BRANCH.

Notice of Excursion Meeting.

A visit by the members of the above branch to Messrs. D. Davis & Son, Ltd., Tylorstown, Ferndale, will take place on Saturday, September 24. It is proposed that members coming from Cardiff shall leave Queen-street Station, Cardiff, by the train due to depart at 2.20 p.m. Members coming from Newport can leave Newport, Great Western Railway, by the 1.34 p.m. Members coming from Swansea can leave Swansea, High-street, by the 12 p.m., both districts joining the Cardiff members at Queen-street, Taff Vale Railway, Cardiff. Members from other parts of the valleys can join the train at Pontypridd Junction, 2.52 p.m.; Porth, 3.10 p.m. Return trains: Tylorstown, dep. 4.56 p.m., 5.40 p.m., 6.27 p.m. Cardiff, arr., 6.19 p.m., 6.46 p.m., 7.29 p.m. Trains from other districts can be found in the time tables. Business meeting: following the inspection of the power station and colliery plant, a meeting will be held at the Jubilee Hotel, Tylorstown; the President, Mr. Sydney F. Walker, will attend. Those members and friends wishing to attend this visit should notify the local secretary on or before September 19.

GERMAN ELECTRICAL AMALGAMATION.

We referred to the approaching union of the Allegemeine Electrizitats Gesellschaft, of Berlin, and the Felten, Guilleaume and Lahoneyer concern. This union takes the form of the Felten Dynamo Works at Frankfort, being taken over by the first-named organisation, who pays for the business in shares, its capital being raised for this purpose from five to six-and-a-half million pounds sterling. The A.E.G., in conjunction with the Electro Bank of Zurich, also acquires a large interest in F.G.L. cable works at Mulheim and Nordenham.

COMPANY REGISTERED.

T. AND J. JACKSON.—£11,000 (£1) (5,000 Preference, 5,000 Ordinary, and 1,000 Deferred). To take over the business of electricians, electric and mechanical engineers, etc., carried on at 14, Park-road, and 15, Hill-street, Marylebone, by T. Jackson and J. Jackson, as T. and J. Jackson and Co. Private. 14, Park-road, Regent's-park, N.W.

THE ENGINEERING AND MACHINERY EXHIBITION.

The Naval, Mercantile Marine, and General Engineering and Machinery Exhibition, which opened at Olympia, West Kensington, on Saturday, and remains open until the 26th, is, from our own point of view, chiefly interesting as affording a good many examples of the varied uses to which electric motors can be put with advantage. We see different types driving large and small pumps, turning lathes and drilling machines, lifts, ventilators, sewing machines, and other appliances. A detailed review of the Exhibition will be given in our next issue.

FINANCIAL NOTES.

ASCOT DISTRICT GAS AND ELECTRICITY.—The directors of the Ascot District Gas and Electricity Company announce an interim dividend of 5% per annum (5s. per share), less income-tax, for the half-year.

* * *

CASTLEDERG AND VICTORIA BRIDGE TRAMS.—The report of the Castlederg and Victoria Bridge Tramway Company states that during the half-year to June 30 there was an increase of £39 in the receipts and an increase of £104 in the working expenses when compared with the corresponding period of last year. After providing for interest, a balance of £20 remains to be carried forward.

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MUSSELS AND ELECTRICITY.

A Problem in Obstruction at Brighton.

Mr. John Christie, Engineer and Manager of the Brighton Corporation Electricity Works, reported to this committee as follows: "At the last meeting of the committee I verbally reported that we were experiencing some trouble due to mussel spawn and other marine growth having got through the strainer, and attaching itself to the inner surfaces of the pipes of our condenser circulating system, where they have increased in size and multiplied in a most alarming manner. Further investigation of the matter shows that the trouble is more serious than I at first anticipated. There is a 5 ft. suction pipe from the harbour, which, some 10 ft. inside the face of the quay, branches off into two 30 in. pipes. Our diver went up the 5 ft. pipe as far as the branch, and reports that beyond it there are clusters of large mussels and other marine growth, some 7 in. thick, all round the inner surface of the pipes. This reduces the effective bore of the 30 in. pipe to some 16 in., greatly restricting the flow of water to the condensers, and putting an overload on the pumps and motors, which they were never designed to carry, in order to circulate sufficient volume of cold sea water to effectively condense the steam and maintain the high vacuum so necessary for the efficient operation of the turbines.

"Mr. Wright has unfortunately been detained in South Africa by illness, and I have been unable to discuss the matter with him. I have, however, gone fully into the matter with his deputy, and have consulted several expert marine biologists, and a few station engineers, who have to work their plant under somewhat similar conditions to ours. They all agree that there is no cure for this trouble except scraping the growth off the pipes by some mechanical means and removing the debris. It is quite impossible to do this in our case, and the only alternative is to provide a new system of pipes laid above the floor, with suitable manholes to give access to them."

At the Council meeting Mr. Councillor German moved the adoption of the special report of the Lighting Committee dealing with the invasion of the condensing-pipes at the Southwick Power Station by mussels. He said that when sea-water came in contact with iron, mussels were the natural result. But the pipes were so large that when they were laid it was regarded as altogether out of the question that they would ever become choked. But the mussels had come in shoals. The Councillor produced half a dozen huge mussels for the inspection of the other members of the Council, and said that out of one part of the apparatus no less than five or six barrow-loads of such molluscs had been removed. All sorts of suggestions had been made as to boiling out the mussels, poisoning them, or electrocuting them; but the position of the pipes and the purpose for which they were used made all such suggestions altogether impracticable. He also referred to the fact that the timber piling of the wharf was in a bad state; and it was proposed that a few of the leading firms who undertake this class of work should submit prices for the renewal in some permanent class of material, such as reinforced concrete. Upon close examination of the piling it was thought that the work would last for about another year, he said, but they wanted to be in a position to renew the work as soon as it became necessary.

The motion was seconded.

In answer to Councillor Booth, Councillor German said the engineer had consulted the engineer of the electricity works of Plymouth and Southampton, and they both had the same trouble. In answer to Councillor Yates, he said the actual mussels did not go through the strainers, but the spawn did, and that, he understood, was microscopic.

The report was then adopted, and Councillor German moved:—

(1) That the offer of Messrs. Richardson, Westgarth & Company, to supply the necessary pipes, valves, etc., to connect up the condenser of the new turbine set (now being supplied by them) with the harbour, for the sum of £870, be accepted, the work to be carried out as an extra under their contract dated July 29; (2) That the work of excavating for, and laying the above-mentioned pipes be carried out by direct labour under the supervision of the Electrical Engineer and in accordance with the plans now submitted; (3) That the cost of the above work be charged to capital account; (4) That tenders be invited for the supply of the necessary pipes, valves, etc., to carry out the new condenser circulating system, and that the work of excavating for, and laying the pipes, be carried out by direct labour; (5) That the Committee be authorised to obtain and submit to the Council schemes and prices for the renewal of the piling of the wharf with reinforced concrete or other suitable material.

He pointed out that the work would be expensive. It would cost about £5 a foot, and there was something like 300 or 400 ft., making a total of several thousand pounds.

Councillor Sone put in a strong plea for expert advice, as the mere tenders or specifications of firms who had a prospect of carrying out the work were, he argued, not a sufficient guide. He moved the exception of the paragraph to the effect that the Committee be authorised to obtain and submit to the Council schemes and prices for the renewal of the piling of the wharf with reinforced concrete or other suitable material.

This was seconded.

Alderman Sendall supported, because those who submitted schemes and prices would be interested parties, and those who would deal with them, viz., the Council, did not possess sufficient technical knowledge to come to a proper decision.

Councillor German consented to take back the paragraph, but he thought the ultimate scheme would be that which Mr. Christie favoured.

The Committee's recommendations as amended were then adopted.

COMPETENT PERSON.

Important Mining Case.

At Linlithgow, Sheriff Substitute MacLeod has delivered judgment in a charge brought at the instance of the Home Office against John Leckie, manager, No. 3 Blackridge Colliery, belonging to the United Collieries, Ltd., and was regarded as a test case. Respondent was charged with having failed, as required by Rule 11 of the Electrical Special Rules under the Coal Mines Regulation Act, to see that a competent person was in charge of the electrical apparatus and machinery while it was in use at the pit in question. The proceedings arose out of a fatal accident which occurred on March 4, whereby a pump attendant was electrocuted.

Evidence at some length was led three weeks ago.

The Sheriff found the charge not proven.

In a long note he stated that the case was heralded as a big fight between the Home Office and the wire managers. The controversy is as to the extent of the electrical knowledge and experience which must be professed by the competent person who must be on duty at a mine where electrical machinery is in use. If the prosecutor could only get the manager interrogated on the useful lines of French procedure his task would be easy, but the manager keeps his mouth closed, and with calm mind observes the futile efforts of his adversary. Now why not make a British approach on French methods by enacting that every manager shall set forth in writing in a book kept in the mine, and open to official inspection, the exact provision which he has made for the electrical supervision of each shift? That would get over the initial difficulty. But other difficulties would at once arise. It would be the prosecutor's next case to prove that the person on electrical duty was not a competent person for that duty. The rule under consideration neither sets forth any standard of qualification nor makes any attempt to set forth the duties which the person has to discharge. It was suggested the rule was a stupid one, but it was not an easy matter to frame a better one.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

If anything further were required to depress electrical and allied industries in this area, it is the latest phase in the dispute between the owners of the shipyards and the boilermakers. A little while ago trade looked as if it was reviving, and electrical engineers were beginning to permit themselves to hope for normal good times. Newcastle-upon-Tyne, however, seems to be the cockpit of the North for the fighting out of any industrial argument that may arise, and Newcastle industry has now to bear the brunt of another faction fight. The general impression here is that the lock-out itself will not be a long-continued one, and therefore neither side will lose so heavily as the by-standers, who are likely to suffer owing to the shock to trading confidence which has thus been given. I have come across more than one representative of electrical firms this week who has said that he has been refused orders because firms do not care to buy much in times of such unsettlement.

Directorial Remarks.

Judging from newspaper reports in this area, Mr. J. H. Ropner, a director of the Hartlepools Gas and Water Company, has, at the annual meeting of that company, been permitting himself to indulge in exultant chuckles and a fervent hope. The chuckles are due to the recent events in Westminster, which, if the newspaper report be accurate, Mr. Ropner described as "practically doing away with electricity for street lighting and going back to gas." The fervent hope attached to this discovery was that the members of the Town Councils of the Hartlepools would go and do likewise. A letter in the "North Mail," however, indicates that carping criticism raises its head even against such splendid enthusiasm. The letter points out that the Westminster City Council only transferred the lighting comprising the supply to 66 arc lamps to the gas company, while there yet remain 1,135 arcs in the City of Westminster. The writer of the letter is not content with drawing Mr. Ropner's attention to this inconvenient proportion; with rather elaborate courtesy he works out the percentage of transference, which is about 5¾ per cent.

A Sales Department at Sunderland.

Meanwhile, in order to show that electricity has not been "knocked out of tune" by the discovery of Mr. Ropner, it may be interesting to refer to an aggressive movement which is on foot at Sunderland. A deputation from the electrical committee has recently been investigating the working of some of the more enterprising metropolitan electricity supply undertakings, notably in West Ham and St. Marylebone, with a view to learning the results of their business-getting methods. As the result of this it is now proposed to form a sales department to provide further outlets for the supply of electrical energy in the borough, including an adequate show-room and the institution of a canvassing staff. A sub-committee of the Electricity and Lighting Committee now has the matter under its consideration.

The General Electric Company and the General Public.

When, some little time ago, the Newcastle branch of the General Electric Company wished to increase its premises, it moved from Clayton-street to Gallowgate, and in so doing went a little further away from the hub of the city, which is Grey's Monument. In order to keep their manufactures before the public, however, the company recently opened a "sample window," where a constant variety of the firm's latest patterns have been shown. Although this has attracted considerable attention, Mr. Spence, the resourceful manager of the Newcastle branch, has, in his endeavours to stop the traffic, placed in his window a model ballooning scene, whose only connection with the firm's industry is the word "Osram" on the balloon.

Electric Lifts.

The firm of Messrs. R. Waygood and Company, Ltd., have recently secured two good contracts for industrial lifts in this area, which are of interest. One of these is in connection with the works of Messrs. Hudson, Scott & Company, Ltd., of Carlisle. Two goods lifts have been ordered by this firm, one for a load of 30 cwt. and the other for 15 cwt. Both cages are six feet square and travel 54 feet at a speed of 150 feet per minute. The former can run nine complete trips per unit of electricity with full load, while the latter can make twelve trips per unit. Car switch control is utilised, a special feature of the gear being that the control is operated in one movement, no reverse being necessary so long as the car is moving in the same direction. The other installation is for the garage of Messrs. Angus, Sanderson & Company, in Percy-street, Newcastle-on-Tyne, and is driven by means of spur gear from a 10 h.p. motor. The lift, which is capable of raising three tons at a speed of 60 feet per minute, has a floor of 24 feet by 10 feet, and a counterweight of 3½ tons. The distance between floors is 42 feet, and car switch control is used.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The party of German students which has been travelling in England under the auspices of the Anglo-German Students' Union, includes a number evidently much interested in electrical matters. By special invitation the privilege of inspecting the General Electric Company's works at Witton, Birmingham, was extended to the party. Before going to Witton the party paid a visit to the new University buildings, at Selly Oak, where they were conducted over the engineering departments by Professor Turner and other members of the staff. They were keenly interested in the Electrical Engineering Laboratory, over which they were shown by Mr. Wall, and paid particular attention to the commutator motor, among other things. One of the recent additions to the collection is a Wilde dynamo with magneto arrangement on the top. This specimen of one of the earliest forms of dynamo has been presented to the department by Messrs. Elkington.

The Witton Works.

At the General Electric Works at Witton every facility was given to the students to study the methods in operation. The works of the General Electric Company during the ten years that have elapsed since they have been transferred from Manchester have grown very considerably, and now employ about 1,500 hands. Motors and dynamos are produced from the smallest capacity up to 3,000 and 5,000 kw., and among the work in process of completion were seen some turbo-generators of 3,500 kw. The visitors were greatly impressed not only by the up-to-date machinery and arrangement of the works, but also by the evidence of the interest taken by the company in the welfare of their employees. For instance, the approach to the works was made through allotments, which are let to the men, and cricket and football grounds provided for their recreation. The motive power for the works consists of a 1,500 kw. continuous current turbo generator and three 355 kw. reciprocating sets. In some of the shops the machines are grouped for driving, but a great feature of the works is the large number of tools, each having its own motor. The works at the present moment are fully employed. The last

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part of the engineering side of the works visited was the tube mill, devoted to the production of steel conduits of various sizes. Afterwards tea was served in the mess-room at the Carbon Works, where the managing director, Mr. Railing, met the students.

Electricity Economises Water.

A significant statement was made last week at the half-yearly meeting of the South Staffordshire Waterworks Company, held in Birmingham. The chairman, Alderman Beale, discussing the decrease of revenue, pointed out that while the figures for domestic supply and supplies for public purposes had increased by a total of £1,189, the trade supplies had decreased during the half-year by no less than £1,462. Among the causes to which this was attributed was the fact that in every manufacturing district water supplies are being affected by the increased use of electricity as a motive power. Where electrical power came in, he said, the steam engine went out, and the consumption of water diminished, and this had to a great extent influenced their trade supplies in the Black Country.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

In preparation for the coming lighting season contractors are getting very busy with wiring work and are in consequence sending in orders for large quantities of cable and accessories to the various suppliers. In spite of the innumerable systems which have been developed during the past few years, in the attempt to cheapen wiring work local contractors seem to prefer the old wood casing or steel conduits, although, of course, samples of the other systems are to be seen. One reason for this apparent want of appreciation for the newer ideas may be the conservative attitude adopted by fire offices and corporations. While, of course, a good sound system of inspection is absolutely necessary to ensure good work, it has the disadvantage of making the struggling contractor very chary of experimenting with new ideas, which the lordly and ungrammatical wiring inspector of the corporation may not approve of, even if his chiefs do. The terror these men can strike into the hearts of the little contractors is marvellous, and in some cases they seem to use their position to indulge personal spite against those who have displeased them in some way. Complying with the needless directions of these people often means the difference between a profit and a loss to the little man.

Cheaper Wiring.

Seeing that only some 11 per cent. of the houses in the country have had electric light installed, and that these have mostly been in places where the cost of installation was not of consequence, or in new houses, where the very slight extra cost over running up gas piping, naturally brings in a very good return in higher rents, and there is obviously much ground yet to be covered. To push this work on, two things are now needed (in bare cost of illuminant, of course, gas is now dearer than electricity), first a really cheap system of wiring, that can be put up with as little trouble as gas lead piping, and secondly, the station engineer to encourage the small lighting load. In all the local stations the power load is growing so rapidly that it takes the suppliers their whole time to keep up, so that for the present the three-light load of the cottage is not considered worth having. Only when a number of these little houses come on together will it be worth the station's while to meet the demand. Handcock and Dykes have shown the small private load to be quite a commercial proposition in itself, even with present wiring systems, but before any great development takes place the landlords of cottage property will have to be shown something much cheaper than anything yet produced.

A Hint for the N.E.C.A.

It might be to the advantage of the contracting business if their organisation were to take the question of cheap systems in hand themselves and develop something to meet the want; the resulting method being patented for the use of members of the association only. By work of this sort they would be doing much more to help their business than by squabbling with station sales departments. Why cannot something on the lines of the German cottage systems be introduced here with low voltages from transformers? (where possible). No doubt one reason is that the different construction of the English houses makes the wiring more difficult to put in and easier to touch. This brings up the question of building itself. The modern method of jerry building cottages is to pile up the bricks as quickly as possible, using wet sand, with a suspicion of lime, as mortar, and then to plaster the whole lot over in the usual way. It would surely be at least as cheap—very probably much cheaper—in first cost to adapt ferro-concrete to cottage property instead of the usual bricks; it would need no plaster. It is conceivable that this construction would be much better for use with a cheap wiring system, in as much as ducts could easily be moulded in the fireproof material. The gas advocates long ago requested architects and builders to so design their houses that gas stoves might be used on the "only correct hygienic principle"—in other words, that they might be "properly installed." The plan as expounded some years ago by one of the leading gas lights, in a municipal engineering paper, involved a complicated ventilation system in the walls and between ceilings and floors, as well as other impossible requirements. If a simplified building would help on the extension of cottage supply—as it seems to have done to some extent in Germany, it is for the contractors to direct the builders' thoughts in that direction.

Bowls by Night.

Apropos of the notes in last week's issue on the playing of tennis, bowls, etc., by artificial light, it is interesting to note that three years ago Dr. Rhodes, of the Salford Medical School, actually did electrically light a small private bowling green near Manchester, using Osram lights suspended from cross-wires. The results—which have been very satisfactory, have been recently published by Dr. Rhodes, and should lead others to adopt the methods. The public parks might make some money out of the idea.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The scheme which is now in course of execution for the augmentation of Glasgow's water supply by the addition of Loch Arklet watershed to the Loch Katrine catchment, is attracting considerable attention in engineering circles, on account of the extent to which electrical energy has been called in to solve the various problems presented by the details of the scheme in combination with the local topographical conditions. Messrs. Charles Brand & Son, Glasgow, are the contractors for the work, and they have decided to drive the whole of the machinery by hydro-electric power. Arklet Burn is captured at Loch Lomond side, and carried back to the higher grounds in the form of electrical energy, where it drives the stone-crushing machines, the derrick cranes, the pumps, the air compressors, the aerial ropeway, and other labour-saving devices. A Pelton wheel of 135 b.h.p. drives two compound generators of 80 kw. each, which generate direct current at 500 volts' pressure. The problem of transport of the 30,000 tons of material to be required in connection with the scheme was the chief difficulty which faced the contractors. Here, again, electricity has come to the rescue, and an aerial electrically driven ropeway has been constructed from Loch Lomond side to the waterworks, a distance of 1½ miles. This method of transporting material is in daily use on the Continent and in America, but it is practically new to Scotland. It forms a cheap and efficient means of transport, especially where steep gradients exist. At the highest point the ropeway attains an altitude of 540 ft. above the level of Loch Lomond. On receiving their load, the skips move slowly up the hill to the discharging terminus, the journey taking about 20 minutes.

Electrically Driven Ropeway.

The construction of the ropeway was quite an undertaking in itself. The materials were conveyed by manual labour up the mountain slopes. The ropeway consists of

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two fixed burden ropes running parallel and supported on steel lattice-work standards having projecting arms at the top. These arms are fitted with cast iron saddles. The heavier of the two ropes, which is 1½ in. diameter, forms the track for the loaded skips, while the empty skips run on the smaller 1 in. diameter rope. One end of each burden rope is anchored to the jetty, and the other end at the unloading station is passed over a pulley and supplied with suitable tightening arrangement. To the heavier rope a weight of 26 tons is attached, and to the lighter one a weight of 16 tons. These weights are free to move up and down in a specially constructed pit. Immediately under the burden ropes is the endless haulage rope. This is of lighter section, passing round the driving drum at the one end and the tension drum at the other. The ropeway is driven by an electric motor of 55 b.h.p., and is capable of carrying 50 tons per hour in loads of two tons each. The plant was supplied by Messrs. Bleichert & Co., of Leipsic, and erected by the contractors themselves. The only alternative to electric drive in such a case as this would have been horse haulage over a special track, and the best that could have been attempted would have been 10 cwt. loads, and even then the work would have been slow and arduous.

Street Lamps in Greenock.

As a result of the surplus of £2,000 on the year's working, the Electricity Department of Greenock have decided to reduce the annual charge for street arc lamps from £18 to £15 per lamp. This, however, only accounts for an annual reduction of £150 on Greenock's annual bill for street arcs.

Electricity in Slate Quarrying.

As the flexibility of electricity supply is realised, the advantages which it offers are attracting various industries which for one reason or another have found themselves increasingly outdone by American and Continental competitors. Slate quarrying in Scotland, for instance, for some years past has been suffering very severely from Welsh and even American competition. The Ballachulish Slate Quarries, Ltd., in the entire electrification of their quarries, have set an example which will doubtless be followed by similar concerns in other parts of the country. This company have just installed two direct current generators, one of 32 kw. and one of 27 kw., generating at 250 to 265 volts, belt driven by suction gas plant. The accessories include an electrically driven pump of the centrifugal type capable of delivering 140 gallons per minute against a head of 100 ft.; electric haulage gear on a gradient of 1 to 2 in places and with a capacity of two trucks taking 37½ cwts. each, the rate of transport being three miles an hour; an electrically driven hoist capable of lifting a single truck 80 ft.; and the necessary switchgear with reverse current and maximum overload devices and trip loose handles. The dynamos are inter-polar compound wound machines, and the entire installation has been carried out by Messrs. The British Electric Plant Company, of Alloa. The work was carried out under the supervision of Messrs. F. E. & A. Milne, architects and consulting engineers, Glasgow, who, although a young firm, have a considerable body of American and colonial experience behind them, and have already secured some important work.

Smoke Abatement Exhibition.

The arrangements are now practically completed for this show, which opens this day week. Neither money nor pains are being spared by the management to make the exhibition a means of education to the public with regard to the possibilities of the various forms of smokeless heat and light. It is now assured that the electrical industry will be well represented. Both the manufacturers and local contractors are seconding the efforts of the Electricity Department's endeavours to make the electrical section worthy of the occasion. It is understood that the Lord Provost of Glasgow will open the exhibition, and a large and distinguished company are being invited to be present at this function. Among others, the members of the Local Section of the Institution of Electrical Engineers have been invited.

General Electric Company.

A week or two ago reference was made in this column to the appointment of the manager of the General Electric Company, Glasgow branch, to an important position in the firm's extensive Australian business. It is pleasing to announce that Mr. Warde's chief assistant, Mr. P. J. Sims, has been appointed manager for Scotland in Mr. Warde's place. Mr. Sims has been associated with the Scotch business of his firm for the past 20 years, and he is sufficiently well known to all branches of the electrical industry in Scotland to warrant the prophecy that the General Electric Company Scotch business will continue to grow in his hands.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

According to the "Technische Rundschau," the famous Spottiswoode coil has given place to a coil which gives a 50-inch spark. The current required is 30 amps. at 110 volts. The iron core is 80 in. long. The primary coil consists of six layers of copper tape, making altogether 792 turns, and the secondary coil contains 100 miles of copper wire about one-hundredth of an inch in thickness.

Re-gilding.

It has long been noticed that articles re-gilded by electroplating are not evenly covered with gilt. The process simply thickens the remaining gold and very thinly coats the bare places, which soon appear worn and shabby. It is, therefore, advisable to strip all the old gold off the article, so that a uniform layer can be re-deposited over the whole surface. A new process for stripping the gold has been invented by a native of Berlin. The article to be stripped is immersed in a suitable galvanic bath. The article is made the anode. Gilt iron is stripped with cyanide of potassium, care being taken to break the circuit the instant all the gold has gone, or the iron itself will be attacked. The new system depends upon the fact that iron, lead, tin and copper, and also their usual alloys are not attacked to any perceptible degree by sulphuric acid of over 50° B., which, nevertheless, dissolves gold under the action of the current if mixed with hydrochloric acid. The electrolytic bath consists of sulphuric acid of 55° B. mixed with 3½% of its weight of crude concentrated hydrochloric acid, and is used at the ordinary temperature. The current required is from two to three volts. The electrodes are three rods of copper, the middle one connected with the positive pole of the battery, the others with the negative pole. The object to be stripped is attached to the positive copper pole.

Single Phase and Polyphase Currents.

The E.T.Z. gives two interesting articles on the relative merits of single phase alternating currents and rotary currents for electric locomotives. In the article recommending rotary currents, the writer remarks that things are often said in technical literature about rotary current motors on theoretical grounds which are contradicted by practical experience. For example, the constant speed is said to be a disadvantage of that form of motor. On the other hand, it is of much benefit in practice, and besides, the great power of the rotary current motor in proportion to its weight, makes it highly suitable for locomotives having to climb long, steep banks. Another German engineer, basing his judgment on the behaviour of the new electric goods locomotives of the Italian State Railways, comes to a quite different conclusion. These locomotives are worked by rotary current motors, and the current is of 15 periods and 3,000 volts. The article states, roundly, that so far as present experience shows, the only possible system for main lines is the one-phase alternating-current motor.

Measuring Magnetic Fields.

Prof. W. Peukert has invented a new method, based on the well-known Hall effect, of measuring the intensity of a magnetic field. If a current is sent through a plate of bismuth situated in a homogeneous magnetic field, the equipotential lines in the plate are rotated, whereby a transverse E.M.F. is produced in the metal, and stands in a simple ratio to the intensity of the field, which can be calculated from the E.M.F.

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Water Sterilisation.

The Felten & Guilleaume Lahmeyer Werke A.G. have invented a domestic ozone-steriliser. The electric lighting current is tapped, and a small portion of it is raised to 6,000 volts by a step-up transformer. The ozonised air passes into a mixing chamber just below the tap, where it is mixed with the water. The transformer and ozonising tube are protected by a strong casing. The apparatus is quite automatic, so that no current is used except when the tap is turned on. It is estimated that the cost of sterilising the water is about a penny per 200 gallons.

Automatic Telephones.

Bavaria is up in arms against the automatic system instituted by the Bavarian post office which does away with a central office. Complaints of failure of the apparatus to act and of its noisiness and slow action when it does, are showered on the authorities, and if something is not done soon there will be trouble. The subscribers have already met and chosen a committee to take the necessary steps for altering the present state of things, which is declared to be unbearable. A public meeting of protest against it is to be held shortly.

Electric Goods Transport.

At Gummersbach on the Rhine an electric railway will soon be laid down for goods traffic. The plans of the engineers, both civil and mechanical, are nearly complete. The gauge will be the standard one, and the line will be 10 miles long, the furthest point from the transforming station being at a distance of five miles therefrom. When possible, passengers will be carried, but passenger fares are only regarded as accidental sources of revenue. The power is provided by a rotary current of 10,000 volts and 50 periods, let down to a direct current of 750 volts by two motor generators, each of 150 kw. This is the current actually supplied to the railway. The goods carried will be mostly stone, and although the inclines are steep, the trains will usually go up empty, the only exception will be for the purpose of conveying quarry requisites. The amount of power expended is reckoned to be 100 watt hours per km. per 1,000 kg. The locomotives weigh about 20 tons. Each has two 60 h.p. motors, and their usual load is to be six trucks. A special carriage will be provided for passengers when required.

Electric Ploughing.

The increased interest now taken in Germany with reference to electric ploughing has excited notice in Berlin, although that city is not apt to infuse very greatly about agriculture. Some far-seeing Germans have, nevertheless, been working at the subject for several years, and have proved that ploughing can be done by electrically driven machinery at a highly remunerative cost. As early as 1895 we had about 3,000 steam ploughs at work in Germany, and now we have only about a dozen electric ploughs. It is true that the steam plough can travel by its own power, while the electric power has to be drawn from place to place by traction engine or horses. If, however, they were multiplied, the necessity for moving them about from one farm to another would not arise. The following table gives average comparative results. The cost of coal is reckoned at 25s. per ton, the cost of 100 kw. hours at 15s. The prices of the plant are concerned with that required to plough 15 acres in 12 hours to a depth of 10 inches in heavy soil.

Kind of plough	Cost of plant	Wages per day	Coal cost per day	Electricity cost per day
Steam	£3,000	4s.	32s.	—
Two-machine electric plough	£1,250	4s.	—	54s.
One-machine electric plough	£1,750	3s.	—	60s.

The day is 12 hours in each case. The horsed plough is cheaper in Germany per hour than the steam plough.

When, however, we consider only the speed at which the ploughing is done, without regarding any of the other advantages of electric ploughing, we arrive at the following results:

Cost of ploughing 60 acres by	steam (approximately)	£40
,, ,, ,,	horse	£32
,, ,, ,,	two-machine electric plough	£29
,, ,, ,,	one-machine electric plough	£25

Company Affairs.

The Brown Boveri & Company, A.G., of Mannheim, is obliged to cut down its dividend for 1909–10 to 4 %, as against 6% for 1908–9, although the gross profits were greater for the latter year, because expenses increased enormously and unexpectedly. Whereas the gross profit rose from 2,453,256 to 2,566,878 marks, the net profit fell from 525,194 to 341,976 marks. The prices obtained were not what they had been in previous years, and the increase in working expenses was largely due to the necessity of increasing the output, a necessity involving increase of plant, and also of the number of persons employed. Things are now, however, looking up. The first three numbers of the current financial year show an increase of turnover, as compared with the corresponding period of 1909–10, of about 15%. Every attempt is, of course, being made to cut down expense wherever that can be done without sacrificing efficiency. Other branches of the Brown Boveri, A.G., tell the same tale, in phraseology slightly varied, but to the same effect. The Baden Brown Boveri Company pays only 8% for 1909–10, and the falling off is due to the same causes. Nevertheless, this company, in conjunction with the Niederoesterreichische Eskompte Gesellschaft and the Vereinigte Elektrizitats Gesellschaft, Vienna, have permission from the Austrian Government to found yet another Brown Boveri Werke Aktiengesellschaft. The capital for the present is 4½ million K. (a quarter of a million sterling), but can be increased to 7½ millions without any extra permission. The chairman is Herr Krassang; the manager, Herr E. Egger. The Vereinigte Gesellschaft will cease to manufacture, and concern itself solely with the finance of the new company.

The Vigiloch Railway.

This is a new telepherage line under construction in the Tyrol. It is intended to be a new departure in mountain railways for passenger traffic, being much cheaper than cable or rackwork lines. It is true that there is a small telepherage at Botzen, but it is on so small a scale that it affords no reliable data. The new line at Meran will be 1·4 miles long, and in that short distance will rise no less than 3,800 ft., so that the average slope is about 1 in 2. The line is in two sections, with an intermediate power station half-way up. The carrying cables are stationary, and are supported by iron bearers, 43 in number, and in some cases 150 yards apart. The motive power is provided by shunt wound motors of 51 h.p., fed by a continuous current of 550 volts. The trains consist of two hanging vehicles, each accommodating 16 persons. The speed is 4 miles per hour, and the time taken going either up or down is 20 minutes. Each vehicle is amply provided with breaking and other safety arrangements and also with a telephone by which the conductor can communicate with the winding stations during the journey. The above-mentioned current is transformed down from a 3,000 voltrotary current supplied by the Zuegg Works. The transformer is a 125 h.p. motor coupled direct with a 60 kw. direct-current dynamo. There is another machine for changing a booster of 110–133 ampere hours, which can, in case of need, work one or both sections of the line.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Great interest is manifested in a new type of railway motor which has just been placed on the market by the Allis-Chalmers Company. This is an interpole motor which has been developed to meet severe conditions of operation, especially on lines which use a potential of 600 volts or over, and with special advantages where a lower voltage is employed. The motor is claimed to be unusually sturdy and strong, with ample provision for wearing surface in the bearings. Special arrangements are made for ventilating the motor and, therefore, very cool running is secured. The field frame is constructed of high quality cast steel and is split horizontally through armature and axle bearings so that it may be opened downward. The commutator and brushes can be readily inspected by means of an opening of large size which can be covered

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when the motor is not being inspected. The main pole pieces are of soft steel punchings, securely clamped between malleable iron end plates, to which they are rivetted. The interpole or commutating pole pieces are of solid steel. The field coils are of the mummified type thoroughly insulated, and with the insulation impregnated with a moisture and water-proof compound. The coils are firm and have excellent heat conducting properties which assist in the cool running of the motor. The bearings are bronze with a thin lining of babbit and are carefully fitted to the bearing housings. Ample lubrication is provided for the bearings, and at the same time there is no chance for the oil to work into the commutator or windings. The armature journals are made amply large and the axle bearing bushings correspond. The standard axle of the American Street & Interurban Railway Association can be used. The gears are made of high-grade cast steel and are furnished either in the solid or split type. The pinions are made from high-grade hammered steel and are bored taper to fit the taper on the armature shaft. The gear case can be supplied either of sheet steel or malleable iron. The former is preferred, as it combines lightness with strength and the Allis-Chalmers Company has worked out a special construction which does away with difficulties formerly experienced. The armature core is built up of soft steel laminations carefully annealed and varnished after punching. They are securely clamped between end heads, which also have rims to support the coil ends a uniform distance from the shaft. The laminations are built up on a cast spider and ventilation ducts are arranged. The spider also carries the commutator so that shaft renewals can be made without disturbing the windings. The coils are wire wound and insulated in the usual way, but after being pressed in steam heated moulds are cooled under pressure, which gives each the same dimensions. This makes the coils absolutely interchangeable, which greatly reduces the labour whenever it becomes necessary to rewind the armatures. Hard drawn copper commutator bars are mounted on a cast steel sleeve. Mica insulation is used between the bars, and a one-piece mica cone ring is employed. The commutator is very carefully constructed with ample dimensions and with creepage surfaces extra long. The 501 motor is rated at 50 h.p. on 600 volts, or 42 h.p. on 500 volts. These loads can be carried for one hour with a temperature rise not exceeding 75 degrees above the surrounding air. It has a continuous capacity of 36 amperes at 400 volts. The motors are designed for either double or four motor equipment and standard gear ratios are employed. The Allis-Chalmers Company is now building, in addition to the type of interpole motor described, a non-interpole type rated at 40 h.p., another type at 55 h.p. and another type rated at 75 h.p.

The Electrification of Railways.

Commenting on the recent discussion at the joint meeting in London of English and American engineers on the electrification of railways, the "Electrical Review," of Chicago, observes that excellent as the papers were, there is no doubt that the difference between American and English conditions of working are such as to detract greatly from the interest and practical value of a joint discussion of this kind. "Continental opinion," the Chicago journal, adds, "seems to be greatly in favour of the single-phase system, and a similar conclusion was reached at the International Railway Congress, held recently in Switzerland. While it must be admitted that the alternating-current motor is inferior to the direct-current motor in certain respects, there are many advantages of great moment in its favour, and the single-phase system is preferable under certain conditions. On the other hand, it seems as if direct current were preferable on railways having a heavy suburban traffic. The results shown in these discussions only serve to illustrate what is very obvious on an inspection of the problem. In any proposition where so many factors are involved and the relative value of the factors is so variable nearly an infinite number of different solutions are bound to appear. In this country we have the records of the New York, New Haven & Hartford, and the New York Central railroads to point to as examples of both single-phase and direct-current operation which are the most convincing testimony as to what has actually been done. And with the rapid development of suburban service, requiring larger power houses at terminals which can gradually be made sufficient for working the line on further stretches in each direction, until it may be desirable to electrify the whole division, the cause of electrification is steadily progressing."

Federal Power Scheme.

The experiment of the Federal Government in entering upon the business of power production at Troy, on the Hudson River, is meeting with a certain amount of criticism. At a cost of $1,300,000, the United States Government is erecting a dam which will extend across the Hudson River for a distance of 1,100 ft. It is to be built of cement and stone from the rock bottom in the bed of the river to a height equal to that of the crest of the present dam. A hydroelectric power house is to be erected on the west side of the river at Green Island, which will use the flow of water on the dam and generate approximately 6,000 h.p. By transmission lines this power will be available not only for the present industries on the Troy side of the Hudson River, but will also offer advantages to other industries both in Troy and Green Island. The amount of electrical energy generated is equivalent to a threefold increase compared with the present hydraulic power. This power will be sold to consumers by the Government at the cost of production, or about a third of the cost of the power generated at Niagara Falls, but the companies using the power will have to meet the cost of the power house.

Current Items.

To prevent operators of small machines driven by electric motors forgetting to turn off the current when they leave them, a mat containing a switch has appeared in the market. When an operator steps from the mat the circuit is broken.

The Pennsylvania railroad officials are still making experiments with wireless telegraphy with a view to ascertaining its efficacy for railroad work. The mast in use for the tests is erected near Altoona, on the mountain, at a point 1,655 feet above the sea level, the receiving apparatus itself being 1,735 feet above the level of the ocean. Communication already has been established with various wireless stations along the Atlantic coast, as well as with various vessels at sea.

Secret Service men have found out how three inmates of the State prison at Charlestown were able to construct a counterfeiting outfit and manufacture spurious half-dollars. The method of the men was very clever. They secured from unknown sources some scraps of tin and lead, a jeweller's crucible, and some plaster of Paris. One of the gang, who had a good knowledge of electricity, cut in on the electric light wires in his cell, attached two pieces of carbon and placed them on a small sheet of iron covered with fireproof cement. On the white-hot carbon the crucible was placed, the metal melted and the coins manufactured.

The work of converting the local steam roads of the Southern Pacific Company at Alameda, California, into a modern electric-traction system is nearing completion. Practically all the track-laying has been finished and nearly all the grading is done. Cross-arm trolley poles have been installed, and the large feed cables placed inposition.

The circumstance that Chicago has just been holding a "Home market week" suggests to the "Electrical Review" of that city the idea of holding an "Electrical Week," and in support of the project the journal urges that it would be an evidence of the up-to-dateness of the manufacturer or retailer if he could announce "These premises are lighted and ventilated by electricity," "Our machines are electrically operated," "This dough was mixed by electricity, and was never touched by the human hand," "We keep the flies from this food by electric fans, from the time the materials are mixed until the finished product is sold," "Our food is cooked in an electric stove, no gas fumes contaminate it," and so forth. There are a million ways of showing forth the merits of electricity in all operations and for all purposes. Have a slogan, illuminate the store windows, advertise in the papers, and make the "Electrical Week" a thing to remember. Follow it up by careful and thorough solicitation. Above all, get co-operation. "Let everybody take a hand," says the editor, "and we believe the results will be astonishing."

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ABERDEEN.—Mr. J. A. Bell, the Corporation electrical engineer, is able to report an increased output of 99,255 units for private lighting, and of 258,040 for power and heating. Although there is still a depressing effect from the use of metallic filament lamps, this is being overcome by the greater number of consumers. It is notable that the consumption of current for heating purposes has jumped up from 18,541 to 41,614. Mr. Bell recommends that the charge for current for heating should be reduced from 1½d. to 1d. per unit.

DARLINGTON.—The Corporation are reducing the charge for meters from 7s. to 3s 6d. This will mean a loss of £200 per year. The price of current for power purposes is also to be reduced. These concessions are rendered possible chiefly owing to the saving realised by the installation of the turbo-generator.

GLASGOW.—From the returns for the year ending May 31 it appears that the Corporation succeeded in adding 1,331 consumers to their list, bringing up the total to 19,489. As a consequence, the amount of electricity sold to private consumers was 34,742,853, an increase of 6·13 per cent. The improvement appears to have been felt all round. The total number of motors connected to the mains on May 31 was 4,851 (32,918 h.p.), an increase of over 500 motors and over 3,400 h.p. The revenue was £245,959, and the expenditure on works and management £105,438. Out of this £43,474 was written off for depreciation, and a little over £96,850 went in interest and payments to sinking fund. A net balance of £190 was carried to reserve fund. Over £96,700 was spent on capital account during the year.

GOVAN.—The revenue of the Corporation Electricity during the year ending May 15 was £18,590. This included £14,636 for sale of current to private consumers at prices ranging from 6d. to ¾d. per unit, £3,305 for public lighting, £574 for rental of motors and £45 from rental of arc lamps. The expenditure was £9,655. The net balance was disposed of as follows: Renewals account, £1,601; depreciation, £242. There has been a reduction in total costs of ·121 per unit.

GREENOCK.—The electricity committee have decided to recommend that the price charged for each lamp be reduced from £18 to £15, a total reduction per annum of £150. This action is taken in consequence of the estimates for the current year, making provision for a net balance of £2,000.

KEIGHLEY.—Various alterations were made to the scale of charges for electricity for motion and lighting purposes. With regard to electricity supplied on the three-phase extra high tension system it was decided that the charge should be based upon £3 per kilowat maximum demand, plus one farthing per unit. The conditions of supply will be:—The consumer to provide transformer on his premises, except upon special terms to be agreed upon with the committee. The Corporation to run the cable into the building and to deliver high tension power at the meter on consumer's premises, beyond which point the consumer can use or transform the current as he desires.

OWSTON AND SKELLOW.—A Local Government Board inquiry has been held by Mr. H. A. Read, M.Inst.C.E., into an application of the Doncaster Rural District Council for sanction to a loan for works of Sewerage and Sewage Disposal for the rapidly-increasing districts of Owston and Skellow, where a large colliery is being constructed. The scheme, which has been prepared by Messrs. D. Balfour and Son, of London and Newcastle-on-Tyne, consists in the laying of several miles of main sewers of cast iron and stoneware pipes, surrounded by concrete, which will be conveyed to an underground pumping station, where the sewage will be automatically pumped by electric motors driving centrifugal pumps to the site of the purification works. These works consist in treating the sewage in liquefying tanks and continuous and sand filters, the effluent from which will be discharged into the Well Syke.

PETERBOROUGH.—A Local Government Board inquiry was held into an application for powers to borrow £2,100 for extension of the electricity undertaking. Opposition was offered, on the ground that the undertaking was not paying its way.

ST. ALBANS.—The St. Albans and Mid Herts Hospital and Dispensary is to be lighted by electricity. Mrs. Herbert, a resident, has taken advantage of this improvement and has generously presented the institution with a full X-ray equipment. Mr. T. E. Eachus is the electrical consulting engineer, and the local firm of Messrs. Giffen Brothers the contractors for the electrical installation.

STEVENAGE.—A communication was received respecting the Stevenage Electric Lighting Order, 1902, from the Board of Trade. With reference to the Council's letter of July 25, on the subject of the Electric Lighting Order, the Board of Trade replied that they would be glad to learn in two months time what steps had been taken to carry out the obligations imposed on the undertakers by the Order. Efforts are being made to obtain a longer period.

ST. HELIERS.—The Jersey Chamber of Commerce are urging the States to acquire the telphone system, in this following the example of Guernsey, where State ownership answers admirably.

TODMORDEN.—A Local Government Board inquiry was held into an application for powers to borrow £300 for lighting the Town Hall by electricity.

OVERSEAS.

BUENOS AIRES.—A decree has been issued approving plans and estimates for equipping the Buenos Aires Custom House with an electric installation, and authorising the General Directorate of Architecture to arrange with Messrs. Zacarías Marioni y Hermano to carry out the work, at a cost of 249,462 pesos currency (about £22,000).

DUNEDIN.—Mr. E. E. Stark, the Corporation electrical engineer, in his annual report, says:—"Every week-day our generating capacity at Waipori has been fully taxed during the past year. The 2,100 kw. machines have been called upon day after day to deliver 32,000 to 36,000 units in the 24 hours; their average load over a period of half-an-hour's duration having been as high as 2,200 kw. Thus it is seen that out of a possible 52,800 units, *i.e.*, 2,200 by 24 hours we have developed 60% to 68% of the maximum possible." The hydro-electric works at Waipori were duplicated last year, but a further increase will soon be required. The connected load is 5,381 kw.

MELBOURNE.—For the year ended February 28 the City Council made a profit of £16,728 out of its electric supply undertaking.

MONTE VIDEO, URUGUAY.—A decree authorises Señor Antonio Rossi to construct three telephone lines from Villa del Carmelo to (1) Colonia Arrué (5½ miles), (2) Ombués de Lavalle (34 miles), and (3) Passo de Camacho (4½ miles). In the construction of these lines the concessionaire is required to use porcelain insulators and galvanised iron wire of 2 millimetres diameter.

TACUAREMBO, URUGUAY.—The municipal authorities are about to instal an electric lighting station, and tenders for the work are being called for. Particulars are given in our "Contracts Open" columns.

TRACTION.

HOME.

COVENTRY.—At a public conference convened by the Trades and Labour Council at the Corn Exchange, the following resolution was adopted:—"That this meeting of Coventry citizens, recognising the great advantages afforded by a properly equipped and municipally owned tramway system, declares that its objects are to stimulate the large volume of public opinion favourable to the project already in existence by public meetings, a petition to the City Council, and a requisition to the Mayor to call a town's meeting, or by any other means which may effectually convince the City Council that it is the emphatic wish and desire of the citizens to own and control the trams."

PLYMOUTH.—Estimates have been prepared respectively for the extension of the Corporation tramway to Laira and a service by trackless trolley, and also an extension of the tramway to Hartley.

OVERSEAS.

BILBAO, SPAIN.—A notice (issued by the Ministerio de Fomento) grants to the "Compañia del Tranvia de Bilbao" a concession for the construction and wokring of an electric tramway.

MONTREAL.—The Montreal Street Railway Company and the Canadian Power Company have amalgamated. The capital of the new combination is sixty million dollars. Large extensions of both tramways and power supply are to take place.

SMICHOW, AUSTRIA.—The communal authorities have decided to proceed with the construction of an electric tramway to Neu-Smichow and to the Malvazinka-Friedhof. The cost of the work is estimated at 1,000,000 kronen (about £42,000).

PERSONAL.

Mr. Charles H. Yeaman has now assumed his duties as chief electrical engineer to the County Borough of Stoke-on-Trent.

Mr. A. J. Howard has been appointed, or, rather, promoted, to the post of Borough Electrical Engineer, Taunton, at a salary of £200 per annum.

Mr. Joseph Holt, senior partner and founder of Holt & Willett's, manufacturers of electric cranes and lifts, Cradley Heath, died on Monday, August 29.

Mr. A. Black has resigned his position as engineer-in-charge at the Bradford Corporation Electricity Works, having received an appointment with Messrs. J. & P. Coats, Ltd., Paisley, N.B.

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EDUCATIONAL.

UNIVERSITY OF BRISTOL.

A Merchant Venturers' Research Scholarship of the value of £50, tenable for one year in the Faculty of Engineering of the University, which is provided and maintained in the Merchant Venturers' Technical College, has been awarded to Mr. Harold Heaton Emsley, B.Sc., Bristol (with First-Class Honours in Mechanical Engineering).

PRACTICAL TRAINING AND PREMIUM APPRENTICESHIPS.

The Cardiff Technical School Committee has received a rather remarkable pronouncement from the Engineering Society of that school. After debate the Society declared that the premium apprentice tends to lower the status of the engineering profession. It is probable enough that many lads, if they had not paid a premium, would be dismissed from works after a very short trial. On the other hand, the payment of a premium is often a drawback to thoughtless lads, who take advantage of their exceptional position to scamp work, being less amenable to discipline.

EAST LONDON COLLEGE.

At this college, which is in Mile End-road, the electrical engineering staff consists of a Professor, Mr. J. T. Morris, lecturer, Mr. L. Murphy, and two assistants. The Intermediate, or First Year course, comprises elementary electrical engineering, including the elements of alternate currents, exercise and laboratory classes. The first final or second year course, Technology; second year final or third year course, Advanced Technology, including design of electrical machinery and electrical energy. Special Honours courses are given both day and evening, and non-University evening classes. The fees are moderate and certain scholarships are open to students.

BATTERSEA POLYTECHNIC.

The electrical engineering department provides a complete practical course extending over three years, and covers the work necessary for a Polytechnic Diploma and the B.Sc. degree of the London University. The head of the department is Mr. A. W. Ashton, who has two assistants, a workshop instructor and instructor in wiring for day classes, an instructor in telegraphy and telephony, and two instructors in electric wiring and house-fitting. There is a handsome lecture theatre and exceedingly well-equipped laboratories. The fees for the University course are £13 13s., per Session, or £4 14s. 6d. per term. Certain entrance scholarships and prizes are available, and there are excellent arrangements on the social side.

CRYSTAL PALACE SCHOOL OF ENGINEERING.

This school, which is eminently a practical one and has turned out a large percentage of successful pupils, will shortly be re-opening for the Winter Session. The scholastic year comprises three terms of about fifteen weeks each. Pupils enter at between 16 and 17 years old and have to pass a qualifying entrance examination, mainly as a test of their ability to undertake solutions of the lecture questions. Courses are given in Mechanical, Civil and Electrical Engineering.

The ordinary curriculum for the Electrical Section in the School is of two Terms' duration, from the beginning of any Term. During the whole period the student's time is devoted to special lectures; instruction, both theoretical and practical, in the shops and offices of the school; and directed practical work on the electrical installation in the Crystal Palace and Grounds. A student thus enjoys the advantage of a close association of theory and practice on a scale not easily attainable. The fees are £21 10s. per term.

UNIVERSITY OF LIVERPOOL.

The session for 1910-1911 in the Engineering Faculty opens on October 4. The first year, intermediate, course, is held during the summer term, the lectures being on Fridays. The course relates to measurement of electric current, potential difference, resistance and power. Standard types of ammeters, voltmeters, ohmmeters and wattmeters. The potentiometer. The fee is £1. The second year, intermediate, or Course B, comprises lectures on Tuesdays and Thursdays, and laboratory practice on Fridays, during the session. The course extends over D.C. machinery, electrical distribution, and electric lighting. The fee for one term is £3, for two terms £5, and for the course £6. The third, final, or Course C, embraces lectures on Mondays, Wednesdays and Fridays, problem class on Tuesdays, and laboratory practice on Tuesdays during the session. The course is very comprehensive, covering general, D.C. and A.C. machinery, batteries and traction. The fees are: One term, £4 10s.; two terms, £6 10s.; course, £8.

SOUTH WESTERN POLYTECHNIC.

The electrical engineering department of the South Western Polytechnic Institute, Chelsea, is under the able control of Mr. A. J. Makower, who is assisted by Messrs. W. A. Oschwald and Murphy as lecturers, Mr. C. A. Taylor as lecturer in wiring, and Mr. H. A. Phillips, instructor in wiring. The full course extends over three years, and enables students to prepare for the degree in engineering of the University of London. There is a fully equipped laboratory, and, moreover, the Institute is lighted by its own generators, which are situated in a thoroughly well equipped and modern central station, containing four sets of lighting plant consisting of direct-coupled engines and compound-wound dynamos of 60, 44 and 20 kw. capacity and a belt-driven set of 55 kw. capacity. These sets have been specially arranged to allow of complete tests being carried out from time to time by students. The switchboards have been specially designed to enable measurements to be made. The dynamo testing room contains more than 20 dynamos and motors of various types for continuous and alternating currents employed exclusively for experimental work. Special evening classes are given, including recommended courses at composition fees held from September to May, the inclusive fees for these evenings a week being 15s. Apprentices, learners and improvers under 21 years of age are, on presenting proper credentials, allowed a remission of 50%.

COMPANIES REGISTERED.

United Lighting and Maintenance Company.—Capital, £2,000, in £1 shares. Objects: To take over the business of electricians, etc., carried on by S. Mundler at 35, Cock-lane, E.C., as the "National Lighting Company." Private company. The first directors (to number not less than two nor more than five) are: M. Kaiser, S. Mundler and J. W. May. Qualification, £25. Remuneration, £20 per annum divided. Registered office, 35, Cock-lane, Snow-hill, E.C.

George Hill and Co., Electricians.—£4,000, in £1 shares. 12, Cornbrook Park-road, Manchester.

Chilian Construction Company, Ltd.—Registered August 25, by Linklater and Company, 2, Bond-court Walbrook, E.C. Capital, £500,000, in £1 shares. Objects: To carry on the business of financiers, constructors of roads, railways, tramways, docks, harbours, piers, wharves, canals, reservoirs, bridges, irrigations, embankments, and any gas, electric light, hydraulic, smelting and other public works and conveniences. Private company. The first directors (to number not less than two nor more than six) are: J. S. P. Samborne (chairman), C. Grenfell, J. E. P. Coyne and P. Burton. Remuneration, £300 each per annum, and £500 extra for the chairman.

Chilian Northern Railway Company, Ltd.—Registered August 25, by Linklater and Company, 2, Bond-court, Walbrook, E.C. Capital, £500,000, in £1 shares. Objects: To undertake a concession granted by the Government of Chile for the construction and operation of a line of railway from Pueblo to Lagunas, to carry on the business of constructors of railways, tramways, electric light and power works and other public works and conveniences, and to adopt certain agreements, the parties to which are not named. Private company. The first directors (to number not less than two nor more than six) are to be appointed by the signatories. Remuneration as fixed by the company.

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PATENTS.

Alternating Electric Current Commutator Machines.

10665.—1909. ALLGEMEINE-ELEKTRICITATS GESELLSCHAFT, Berlin. This is an improvement in the regulation of dynamo electric machines of the alternating current type having two working and two exciter windings. The motor armature has main brushes and exciting brushes. The inducing on the stator has its magnetic axis in line with the main brushes, while the stator exciting winding produces a flux in line with the exciting brushes. The main transformer supplies the motor and the exciting transformer has its primary in series with the main brushes and its secondary in series with the exciting brushes. The controlling switch has any suitable number of contacts. A switch is arranged in the connection which completes the closed circuit through the rotor, exciting transformer and stator exciting winding. A reversing switch is provided in the secondary circuit of the exciting transformer whereby the field excited by the rotor as well as the rotor working potential may be reversed.

Shock Absorbing Mechanism for Semaphore Signals.

17673.—1909. A. T. BLACKALL, AND G. NEWMAN, Reading. A buffer spring is inserted in one of the rods which connect the semaphore arm to the mechanism in the signal cabin. This rod is formed in two portions, one of which is provided with a shoulder and is made to telescope within the other portion. A spring rests on the shoulder and bears against the outer portion of the rod.

Automatic Regulation of Dynamo Electric Machines.

17739.—1909. H. M. TAYLOR, AND R. H. SCOTSON, Middlesburgh. This means for controlling the voltage of an electric supply comprises an exciting winding, a resistance in series with the winding and a short circuiting device automatically actuated by the voltage to be controlled adapted to render the winding inoperative.

Electric Telegraphy.

17774.—1909. S. G. BROWN, AND A. R. HARDIE, Finsbury Pavement, E.C. A moving coil in the receiver controls a microphonic contact device comprising metallic conductors which are in continual contact and adapted to be maintained in a continual state of tremor whereby the sensitiveness of the instrument is greatly improved.

Electric Driving Mechanism for Clockwork.

17888.—1909. L., F. C., AND H. V. WEBBER, Bristol. The driving mechanism comprises a continuous ratchet formed by gearing two wheels one in the other with a thruster working on either wheel through the movement of a locking lever to which pawls are attached. One of the poles of the electro-magnet is divided and both halves of the divided pole, together with the complete pole are focussed on the poles of a permanent magnet so that by reversing the poles of the electro-magnet they will attract and repel the poles of the permanent magnet in the same direction at the same time.

Flash Light Switches.

17895.—1909. C. H. JUKES-BROWN, Strood. A metal tube with an insulated heating coil is fixed at one end of the switch so that when heated by the flow of current in the coil it expands in one direction. This expansion works a lever to give great amplification of movement. The end of the lever is jaw-shaped and carries electrical contacts which are insulated from each other. When the flasher is started the current is sent through the coil and heats the metal tube. This causes a beam to bring an arm to the second contact screw. The current is then directed towards the lamps which it lights up. The metal tube and coil cool and contract. The lever follows the direction of contraction and causes the arm to be brought over to the first contact screw whereby the lamps are put out as the current has to go through the resistance coil. The tube is again heated and in this way an automatic action of lighting and extinguishing the lamps is set up.

Twin Searchlights.

17904.—1909. SIEMENS BROS. & COMPANY, LTD., AND J. H. BRADLEY, Westminster, S.W. In order to enable the twin barrels of the searchlight to be capable of moving independently over a very wide angle and to be brought into exact parallelism even at the extreme end of its movement if necessary a common vertical pivot about which the barrels are trained is arranged at the rear of both the barrels and is in line with the middle of the space which separates the barrels when they are parallel to each other.

Electrolytic Bleaching Apparatus.

23629.—1909. E. WEICHERT, Augsburg. The walls of the electrolyte compartments of the apparatus are formed of bricks made of refractory material. Strips of platinum iridium are placed between the bricks and bound with cement to form an impenetrable partition.

Safety Indicator for Electric Lifts.

17998.—1909. P. T. KENNY, New York. The object is to take the control out of the hands of the operator when a dangerous speed of the lift is reached and to apply a brake if necessary. Warning of the removal of control by the operator is signalled by a light in the car. When the speed is decreased to normal a further signal is given to the operator that the lift is again under his control.

Encasing Electric Wires.

17999.—1909. P. T. KENNY, New York. The moulding for encasing the wires comprises a main part and a cover, one or more longitudinal grooves in the interior of the main part of the cover for the reception of the wires and one or more exterior grooves on the underside of the main part which receive and hold on the fastening devices projecting from a suitable base.

Friction Gearing.

18222.—1909. K. ALQUIST, Rugby. The magnetic device for effecting the necessary pressure between the driving and driven parts of the gearing comprises a pair of cylinders on each of the shafts. The cylinders are placed opposite each other and those on one shaft make contact with those on the other that are of equal diameter. Round the axial line of contact between the one pair of cylinders and parallel to the longitudinal plane through the line, the coils carrying the current necessary to excite the magnetic field are placed. Exciter coils may be placed round the contact lines of both pairs of cylinders.

Electric Advertising Signs.

18310.—1909. H. H. CLEMENTS, Strand, W.C. The glass faces and interior wiring of this kaleidioscopic sign are so arranged that the sign has two faces which project the illuminated effects in opposite directions.

Electrodes for Arc Lamps.

18469.—1909. F. M. LEWIS, Brighton. Hitherto the flaming material has formed the core of the electrode, but according to this invention the flaming material forms a sleeve which surrounds the electrode. The flaming material while in a plastic state is squirted over the carbon. At the same time an obstacle is presented to the flow of the plastic material which causes it to be highly compressed upon the carbon. Any means may be adopted for applying and retarding the flow of the plastic material. A further patent 15977—1910, protects a new flaming material consisting of a mixture of equal parts of calcium fluoride and silicon carbode. For hollow cores of 11 millimetres diameter with walls of 2½ millimetres thickness a layer of this new flaming material of 1 millimetre thickness is calculated to give the best results.

Receiving Apparatus for Wireless Telegraphy.

18922.—1909. G. MARCONI, AND MARCONI'S WIRELESS TELEGRAPH COMPANY, LTD., London, W.C. The receiver contains two circuits, the first of which is a high frequency circuit embracing the antenna and containing the detector, while the second is a low frequency circuit connected to the detector and contains an indicator. The indicator in a separate low frequency circuit is indictively coupled to the low frequency circuit of the detector. Both these circuits are independently tuned to the time period of the groups of oscillations which when a telephone is employed should be such as to cause the production of a clear musical note.

Recording and Indicating the Working of Electric Lifts.

19203.—1909. H. A. MATEAR, T. F. KENNEDY, AND H. WOODHOUSE, Liverpool. The working of the lift is recorded and indicated by a marker and recording sheet. The movement of the lift operates the marker, whilst the recording sheet is moved by the stopping and starting of the lift. The marks on the sheet show by their positions the proficiency of the operator.

Electric Induction Furnaces.

24302.—1909. A. HIORTH, Christiania. This is an improvement in furnaces the hearths of which are tilted independently of the magnet system and in which the primary winding is distributed partly above and partly below the hearth. The upper coils are so arranged that they can be removed without disturbing the rest of the furnace when tilted to discharge the metal.

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Transmission Dynamometers.

25012.—1909. W. H. KENERSON, Providence, U.S.A. The object is to produce a torque measuring apparatus possessing a greater degree of efficiency and accuracy and at the same time occupying a smaller space than those hitherto employed. The fluid (which operates a pressure gauge and indicates the turning effort of the shaft), the fluid chamber, the operating diaphragm and the immediately contiguous members are all stationery so that there is no centrifugal force generated to affect the working fluid, and the readings on the gauge are unaffected by changes in speed of the shaft. No slip joints and packings are employed. The apparatus is adapted for taking readings with shafts rotating in either directions.

Automatic Telephone Exchanges.

27458.—1909. SIEMENS & HALSKE, A.G., Berlin. The invention is based on the conception that the percentage of simultaneous conversations in a large group of subscribers is much smaller than in a small group, and that it should, therefore, be possible to economise considerably in first group selectors in the case of large groups of subscribers. For example, in a group of 2,000 subscribers only 50 first group selectors should be necessary if each of the 2,000 subscribers could make use of each of the 50 selectors. The invention realises this possibility by causing the switching mechanism to co-operate with a second automatic step by step switching mechanism when the subscriber lifts his receiver, so that the subscriber is connected with a disengaged group selector over both switches. In consequence of this two-fold automatic selection a large number of group selectors is rendered available to each subscriber, the selectors being connected with a considerable number of subscribers' lines.

Charging Electric Resistance Furnaces.

27674.—1909. A. PETERSSON, Odda. A part of the charge is introduced into the upper part of the furnace in the usual manner, while a cold non-conductive charge is forced into the furnace by means of mechanical feeding devices through openings in the sidewalls or bottom of the furnace and between the electrodes of different polarity so as to maintain a comparatively cold layer of material in the walls and bottom in the hot zone of the furnace for the purpose of preventing the short circuiting of the current through the furnace walls or bottom.

Single Phase Commutator Dynamo Electric Machine.

29090.—1909. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. This is an improvement in single-phase alternating-current machines which have their main field windings cross-connected for mutual excitation. The improvement consists in the employment of stator windings the axes of which correspond to the axes of compensation windings supplied with current from a source the potential of which is of such a phase that the components of the armature potentials due to self-induction are wholly or partly neutralised.

Regulating Gear for Winding Engines.

29446.—1909. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. In this controlling arrangement for regulating the variable supply of energy to the main motor, a differential gear is used, two members of which are driven respectively by the main and auxiliary motor, whilst a third member acts in combination with a depth indicator.

Electrically Operated Indicating and Controlling Devices.

827.—1910. SOCIETE D'ELECTRICITE "NILMELIO" & J. E. COLAS, Paris. The energy for working this device is generated by a magneto electric machine which produces the current required at the desired moment. The distribution of this current can be regulated or cut off by an interrupter, the position of which is so controlled as to ensure the current being supplied according to the conditions required for the normal working of the corresponding device.

Purifying Liquids by Electricity.

1461.—1910. H. R. HARTMANN, Pittsburg, U.S.A. This circuit control mechanism for liquid purifying apparatus comprises a casing, a valve arranged to normally close a passage through the casing, and a circuit controller. The valve and controller are controlled by the liquid in a manner to maintain the circuit closed slightly longer than the flow of the liquid through the apparatus. A further patent (1462.—1910) provides means for reversing the current. This comprises a reversing switch, and a motor actuated by the flow of the liquid that is being purified for actuating the reversing switch periodically during the flow of the liquid. The liquid flows to the motor only when it is flowing through the purifying apparatus.

Telegraphic Relays.

2349.—1910. I. KITSEE, Philadelphia, U.S.A. The relay is provided with contacts consisting of graphite. The first contact is operatively related to the movable part of the relay, and terminates in a graphite point. The second contact presents to the first contact a disc-like surface of graphite.

Electric Fire and Burglar Alarm Contact.

5510.—1910. J. PHILLIPS-WOODEY, Southend-on-Sea. A bulb form is fitted in the centre of the ceiling. Round it are a number of petals held away from the bulb centre by silk or cellulose strips. These strips are carried across the ceiling to the top of the walls, the windows, doors, and down to the skirting. Breaking of the silk through the door or window being opened, or through being burnt, causes the released petal to spring and touch the bulb, causes an electric alarm to ring.

Indicating, Recording and Integrating Dynamometers.

5683.—1910. W. J. CROWELL, Lebanon, U.S.A. The invention provides a cheaply constructed dynamometer of the class in which a sleeve is caused to travel longitudinally of a shaft a distance which is proportional to the torsional strain which passes through a spring. The sliding movement of the sleeve is communicated to a slidably mounted conical wheel which is revolved by the drive shaft, and varies, according to its movement, the number of rotations of the friction wheel to a recording instrument.

Electric Trolley Wires.

8831.—1910. M. JELLINEK & J. F. DE TOVAROS, Budapest. In order to equalise the longitudinal expansion or length variations which occur as a result of variations in temperature in trolley wires suspended from carrier wires by means of tension weights acting on the ends of the trolley wire sections, it has been necessary to provide between the trolley wire and the carrier wire a connection capable of yielding in the direction of the trolley wire. According to the invention, the trolley wire holders are connected with the carrier wire by means of suspension wires at at least two points as remote from each other as possible. While ensuring their horizontal position, any longitudinal displacement of the wire holders is impossible. At the same time, the trolley wire holders loosely embrace the trolley wire and enable its displacement.

Primary Battery Electrolyte.

9176.—1910. B. E. R. NEWLANDS & R. M. PARKINSON, London, E.C. This improved preparation for making electrolytes for primary batteries is made by mixing together 200 grammes of sodium bichromate, 117 to 112·5 cubic centimetres of concentrated sulphuric acid, and 36·33 to 58·1 grammes of dry sodium sulphate. The sodium sulphate enhances the dryness of the powder, and makes it better adapted for packing.

Electric Circuit Breakers.

10771.—1910. CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee. This circuit breaker comprises a main switch and an auxiliary switch carried on a longitudinally movable rod. The rod is guided by an extension of one-pole piece of an electromagnet which operates to release the switches so that they move to the open position on the occurrence of an overload in the circuit. The arrangement of the extension of the pole piece also enables the lines of magnetic force between the magnetic poles to be utilised to extinguish the arc formed on the opening of the auxiliary switch.

Bent Lever for Interrupters.

13589.—1910. R. BOSCH, Stuttgart. The lever is formed from a sheet of metal bent twice, so that throughout its length it has an L-shaped crossed section. Two laterally projecting the ears are bent at right angles to the sheet, after which the sheet is bent at a right angle to cause the ears to overlap. The ears are rivetted together. By these means a rigid and compact lever is formed.

Electric Ignition in Internal Combustion Engines.

13899.—1910. R. BOSCH, Stuttgart. This is an improvement in engines of the type in which adjustable cams actuate an interrupter device which rotates with the engine. According to the invention, stationary cams operate a stationary interrupter through the medium of an intermediate member.

Constructing Magneto Electric Ignition Machines.

14575.—1910. R. BOSCH, Stuttgart. This improved method of making an armature casing for magneto electric ignition machines for internal combustion engines consists in connecting the pole pieces to form a solid whole with the casing of non-magnetic material by pressing the casing so that it suffers such an alteration in shape and such an increase of cross section that the laterally extending material of the casing tightly embraces the pole pieces.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.						Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Aug. 31	1,681	1,311	+ 69	— 261	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Aug. 28	1,082	1,040	+ 42	+ 552	24·089	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	Aug. 27	6,768	6,233	+ 535	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,109	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29¼	29¼	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Aug. 27	5,088	4,762	+ 326	+ 3,621	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Sept. 4	1,273	1,218	+ 55	— 43	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Sept. 2	6,314	5,970	+ 344	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Sept. 3	1,198	1,252	— 54	—	19¾	19¾	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Sept. 4	269	265	+ 4	— 12	6¾	6¾	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Sept. 3	4,931	4,695	+ 236	+ 2,661	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27*a*
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Sept. 4	2,982	2,973	+ 9	+ 204	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Sept. 1	519	504	+ 15	+ 1,636	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Aug. 19	1,760	1,693	+ 67	+ 3,337	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Sept. 2	189	166	+ 23	+ 70	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Sept. 2	6,431	5,822	+ 609	+ 731	54¼	54¼	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 560	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Sept. 3	1,053	977	+ 76	+ 578	15	15	Mar. 31	47,439	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Aug. 27	16,967	16,841	+ 126	+ 11,219	195¼	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28¼	,, 31	84,704	16,200,029	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Sept 3	2,800	2,685	+ 115	+ 3,439	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10¾	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Aug. 31	141	162	— 21	— 185	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Aug. 31	1,242	1,319	— 77	— 671	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96¾	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Aug. 28	1,430	1,423	+ 7	+ 9	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Aug. 24	41,915	36,359	+ 5,556	+ 118470	135½	124	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Sept. 3	9,457	9,054	+ 4 3	+ 5,593	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Sept. 4	15,979	15,536	+ 443	+ 5,032	24¼	24¼	June 30	680,257	99,816,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2¾	2¾	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Aug. 27	3,702	3,728	— 26	+ 887	60¼	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14¼	14¼	,, 31	35,531	8,174,003	798,029	1·34	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 383	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28¾	28¼	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74¾	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Aug. 28	5,838	5,587	+ 250	+ 7,714	39¼	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Aug. 24	1,240	1,201	+ 39	+ 549	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	905	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 10	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Aug. 27	1,023	966	+ 56	+ 63	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	— 97	+ 1,985	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21¼	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *b* Half-years' figures.

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THE
Electrical Engineer.
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NOTES.

Municipal Tramways Conference.

The Municipal Tramways Association holds its annual Conference at Bradford on Wednesday, Thursday and Friday of next week, the session being opened by a meeting of the Executive Committee at the Town Hall at 10 o'clock, the official reception by the Lord Mayor being timed for half an hour later. The Presidential address will be delivered by Mr. C. J. Spencer, the City Tramways Manager. On the same day papers will be read by Mr. Alderman Flint on "The First Decade of Municipal Tramway Work," by Mr. J. W. Dawson, assistant engineer, Bradford, on "The Comparative Durability of Brake Shoes and Tyres." On Thursday the papers down for reading and discussion are: "Tramways in Relation to Town Planning," by Mr. A. Baker, general manager, Birmingham; a report on "Lubrication of Car Bearings," prepared by Messrs. E. Cross, R. L. Acland, P. J. Pringle, and T. R. Smith will be given, and the discussion thereon will be opened by Mr. C. W. Hill, general manager of the Bournemouth Corporation Tramways. A full and enjoyable pleasure programme has been arranged, including a tramway ride in special cars from the Bradford Town Hall to Halifax, which will be of great interest as demonstrating tramway construction and operation on hilly routes.

Corrosion on Iron and Steel.

It will be remembered that a committee is now investigating the corrosion of the non-ferrous metals. This useful work is to be supplemented by another body dealing with the ferrous metals, the British Association having appointed a committee to report on the corrosion of iron and steel, and have made a money grant towards the work. The members of the committee are: Professor Arnold (chairman), Mr. W. E. Turner (secretary), Professor McWilliam, Professor Wynne, Mr. Cyril Chappell, and Mr. F. Hodson. With the exception of Professor Wynne, of Birmingham, the committee consists of Sheffield metallurgists.

Manchester Students' Section, I.E.E.

Evidence of the businesslike alertness of the Manchester Students' Section of the Institution of Electrical Engineers, is afforded by the circular just issued to members, referring to the coming winter session. It contains the following list of subjects suggested for papers: Automatic Circuit Breakers; Single and Polyphase Alternating Current Motors; The Use of Electric Motors for Industrial and Marine Purposes; Electro-Chemical Processes (including Electric Furnaces); Electrical Power Transmission and Distribution; Electrical Instruments and Meters; Street Lighting; The Manufacture, Testing and Laying of Electric Cables; Wireless Telegraphy and Telephony; The Application of Electricity to Railway Signalling; The Lay-out of High Tension Switchboards; Commercial Engineering and Organisation; Electrical Equipment of Battleships; Winding Engines and Mining Machinery; The Electrification of Existing Steam Railways; Transformers—Static and Rotary; Internal Combustion Engines (applied to the Generation of Electric Power); Electrical Heating and Cooking; and Textile Equipment. It will be seen that the Executive are thoroughly up-to-date and alert to local as well as general needs. If even a third of the subjects suggested can be dealt with, a most valuable programme will result.

Building and Electrical Facilities.

In our last week's batch of notes from Glasgow allusion was made to the enormous assistance rendered by electricity in carrying out a big engineering contract, in connection with the city water supply extension. At present there are two striking examples in London of electrical aids in building. Immediately west of the Central Law Courts in the Strand a huge extension is going up, but the work is being carried on behind tall hoardings, and without the accompaniment of the noisy steam cranes. Indeed, a wonderful silence prevails, although the buildings are going up with unusual celerity. This is due to the use of electric hoists in the place of steam derricks. The same course has been taken at the Savoy Hotel, where considerable extensions are also being carried on with feverish haste but without noise.

Newfoundland Developments.

Newfoundland deserves to be carefully considered by electrical engineers and manufacturers. The Premier, Sir E. P. Morris, has shown the determination both of the Government and the community to develop the country. Investments are foreshadowed in mining, fish curing, timber, wood pulp and other industries. All this will mean that cheap power will be required. Part of this could be supplied by hydro-electricity, but probably the steam turbine will be more in request for generating electricity. In any case, the immediate future should call forth a good demand for electrical appliances, and these could be just as well supplied from our shores as from the United States. It is all a question of being on the spot and alert to satisfy needs as they arise.

Electro-Chemical Theories.

While we have been listening to reports before the British Association, dealing with the most minute investigations of certain phases of electro-chemistry, Professor James Moir, in his inaugural address before the Chemical, Metallurgical and Mining Society of South Africa, has been discussing the subject, with a slight leaning to scepticism. He said: "In the electro-chemical theory I have to confess myself a Conservative. I cannot digest the conception that our atoms are wholly aggregations of electrons: I cling to matter, even if it be only as the 'sphere of positive electrification,' a fiction which the electronists have (apparently unwillingly) to postulate to hold their electrons together. I think the evidence shows the great bulk of the atomic weight to be non-electrical, *i.e.*, that the electrons are simply 'an extra,' a sort of vivifying principle. They are certainly connected with chemical affinity, a force which is too intense to be explained in terms of gravitation alone. As Nernst says, 'It has become evident that electrical forces unquestionably play a great part in many "purely chemical" reactions.'"

"Chemical Affinity" and After.

Dr. Moir went on to declare that in all likelihood "chemical affinity" was a mere combination of electrical forces, valency being due to a special local aggregation of electrons. "The conception," he added, "of atoms losing some of their electrons without very serious alteration of properties must be considered. Many obscure colour-phenomena, *e.g.*, those of ruby, sapphire, and fluor spar, as well as the effect of light on silver salts, seem to belong to this category. There are all stages of stability amongst compounds, and there is every reason to extend the idea to elements. Gold may never be synthesised, but it may

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quite likely be broken down, given sufficient command over temperature and pressure. I am also not quite satisfied that the *a* particle of radium is a helium atom with two electric charges. I think it more likely that it has atomic weight 2 and only one charge and that when stopped the two half-heliums lose their charges and combine to form inert helium. The evidence for the manotomic molecule of helium only proves that the molecule has a single sphere of influence."

Bolivia Will Want Electricity.

A valuable report from the Belgian Legation at La Paz dwells on the condition of the electrical industry in Bolivia, and draws attention to the circumstance that, owing to the high price of coal and other fuel in that country, there is every prospect that greater use will be made in the future of the abundant waterfalls and rivers for electrical purposes. Hydro-electric plant, continues the report, will therefore be in increasing demand in Bolivia, especially high-tension generators with high-pressure hydraulic motors.

Tungsten Lamp Shock Absorbers.

A device likely to prove a boon to all who are interested in the use of metallic filament lamps for street lighting, in factories and other situations peculiarly exposed to shock and vibrations, is being introduced by the Tungstelet Company of New York. It is an ingenious contrivance in the form of a plunger shock absorber, by means of which the weight of the socket and shade is balanced against the compression of a spring, which takes up all vibration. It has come triumphantly through all laboratory tests, which are said to have been more severe than anything occurring in actual practice. The original fragility of the tungsten filament has already been minimised to a considerable extent, and clever lamp construction has also lessened the drawback. But there is no gainsaying that a really effective shock absorber would promote the wider use of these lamps for outdoor lighting.

Making Surety Trebly Sure.

A remarkable case of an electric power plant being equipped with three prime movers is reported from Nevada. It appears that the Winnemucca Light & Water Company's plant can be run alternatively by a 150 h.p. Pelton water-wheel, a 175 h.p. gas engine, or a 125 h.p. steam engine. They are all belted to the same driving shaft in such a manner that any one, two, or all three may be used to operate one or both of the two 50 kw. generators. The gas and steam engines are, however, used as stand-byes, when the water is low. The water-wheel is supplied from a reservoir of 500,000 capacity, two miles away from the plant, and provides ahead of 1,100 ft. at maximum. The water discharged from the wheel is collected in settling tanks, and is thence distributed over the town of Winnemucca.

Solar and Wind Engines.

Of course, Professor Fessenden's paper on harnessing those natural stores of power—solar heat and wind—have called forth an unavoidable avalanche of criticism, couched more or less in terms of ridicule. But many serious engineers regard the subject as merely premature. At present coal is too abundant and cheap to call for any such heroic effort as foreshadowed by the Canadian Professor. The initial outlay would make competition with cheap coal impossible. However, it is all largely a question of degree. For immediate practical purposes, harnessing the wind gives the greater promise, and, indeed, this is being done in a small way to a very considerable extent, windmills being utilised to generate electricity in conjunction with storage batteries.

Bonus to Electrical Workers.

Mr. J. A. Bell, Aberdeen's Electrical Engineer, whose excellent homily to local architects was referred to last week, has made another good move. He reported to his committee as follows: "The reduction of works' costs, after reaching a certain level, is very largely a matter of each employé on the running staff in the engine-room and boiler-house personally exercising every economy possible. Very good results have been obtained in other generating stations by means of bonus systems. I think that a trial of six months might, with advantage, be made, and I suggest that the sum of £25 be allowed for bonuses during that period. If the committee sanction this, it would be necessary to fix a basis to work on. Some 11 to 15 men would be affected by this scheme, and benefit by it if they earn their bonuses by results." The committee cordially approved of the suggestion, and remitted to the convener and the electrical engineer, to adjust the details of the scheme and report at the end of the six months.

Electric Lighting Further Powers Bill.

The Corporations of Burton-on-Trent, South Shields, Luton and Nelson have asked the Incorporated Municipal Electrical Association to be added to the list of those who will actively support the application for an amending Act, while Oban, Redditch and Neath will give their moral support to the movement.

POWER PRODUCTION FOR FACTORIES.

At the first Congress of the newly established Textile Institute, Mr. T. R. Wollaston, of Manchester, read a paper on "Gas Power and the Uses of Producer Gas in Textile Mills," in which he strongly advocated the use of gas engines in place of steam. In the course of the discussion, Mr. CROWLEY, of Stafford, said that recent developments in Lancashire and Yorkshire, and also on the Continent, made it almost inevitable that electricity would be the connecting link of the future between the prime mover and the machine, and the steam turbine was much more suited to the generation of electricity in the units required in the factory than the gas engine. Central station engineers all over the country were installing turbine units, and few would have the courage to risk the trial of gas engines after the disastrous experience at Johannesburg.

Colonel H. A. FOSTER said that his firm were at present installing at their mills at Queensbury an electric drive at some distance from the main works. At first he was strongly in favour of gas, but after going into the matter very carefully with the best expert advice obtainable, they had decided on an electric installation driven by a high-speed steam engine working at 180 lb. pressure, the steam from which would be afterwards available at low pressure for use in the works. A great drawback of producer plants was the polluting effluent from the gas washing. He laid stress on this because he was a member of the West Riding Rivers Board. He was not going to preach "trout before trade," but this was a matter that ought to give pause to those who recommended the general adoption of gas engines.

Dr. ORMANDBY argued that the present wasteful way in which we were using up our national assets in the form of coal was simply ridiculous. A steam engine had a thermal efficiency of only about 16%. The thermal efficiency of a gas engine was about 27%, or two-thirds more. There was really no saving in working costs, because although the gas engine required less coal than the steam engine, the coal cost four times as much. In capital charges there was a saving, because it was not necessary to build a chimney. With regard to Colonel Foster's point, the difficulty of the poisonous products from washing had been largely overcome as the result of some clever research work by Dr. Fowler, of the Manchester Corporation. Dr. Fowler had got hold of some bacteria which positively throve on these phenol compounds. When turned loose on them they simply chewed them up, and the result was an effluent from which all the poisonous material had been removed.

Mr. WOLLASTON, in replying, admitted that there were immense advantages in certain cases in electrical transmission, but he did not think it came within the scope of his subject. To Mr. Crowley, who said that steam would continue to be used exclusively in central electricity generating stations, he would say, "Wait and see." It was just possible that he knew a little more of what was happening in that direction than Mr. Crowley. It was his firm conviction that before long gas plants would be put down to take the average load, and the steam plants would be used for the peak loads only. The pollution difficulty could be solved in many cases by putting down a water cooler in conjunction with some rough process of filtration and using the same water over and over again. Moreover, quite a number of air-cooled plants were now being put down, which used very little water indeed.

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THE BRITISH ASSOCIATION.

One of the notable features of the meeting was the paper on atmospheric electricity and its influence, read before the Mathematical and Physical Section.

Atmospheric Electricity.

Dr. Charles Chree, in introducing the subject of atmospheric electricity, said that the potential gradient had received most attention. As regarded the absolute size of the potential gradient, close to the ground 100 volts per metre appeared a low estimate for the mean in temperate latitudes. Taking even 100 volts per metre, they had 300 volts at the level of the summit of a 30 metre tree in the free air. The tree itself retained the earth's potential, and reduced the potential in its neighbourhood, but that disturbing effect died out at a small height above the top, so that there was a very steep potential gradient surrounding the summit of an isolated tree, and also surrounding the ends of long horizontal branches. In a thick wood it was only above the summits of the trees that the gradient was steep.

It seemed not improbable that these facts might have an appreciable effect on the growth and health of trees. The fact that the presence of a potential gradient influenced the growth of plants had been discovered at least 25 years before. Of late years, a certain amount of experimental work had been going on involving the application of artificial fields. Sir Oliver Lodge, among others, had been immediately interested in that work. It was by no means improbable that at no distant date the subject might become of great agricultural interest, and another point of likely economic interest was the possibility of utilising the potential gradient as a source of power.

The immediate cause of a lightning discharge was still rather obscure. Dr. Simpson had discovered that the breaking up of rain drops produced electrification, and had advanced an explanation of thunderstorms based on that property. His theory required an ascending air current of high velocity, and from a meteorological stand point there were various difficulties in the way. Accepting the existence of thunderstorms as a fact, there were numerous problems requiring further investigation; for example, whether the discharge was uni-directional, or oscillatory; how long it lasted; what quantity of electricity passed; what soils and species of trees were most likely to receive discharges; and was there any lunar, or sunspot, or other period?

Sir Oliver Lodge, who followed, argued that the subject was one of great importance, and that there were great future developments contained in it. He thought it was possible to convert by artificial means potential energy into kinetic. If electrification had an influence on the weather, it would appear possible that on those lines some artificial control of the weather, or, at any rate, some modification of the weather, might some day be established. If he were a large capitalist he would try to electrify the air artificially on a large scale. He would reverse the gradient or intensify it and watch the effect. The earth suffered more from drought in the whole than from rain, and he was told that in West Australia they saw the clouds gather but disappear without a drop falling. If clouds could be made to discharge some moisture it would be of great importance.

Dr. Shaw, discussing Sir Oliver Lodge's suggestion as to artificial experiments, said that was a thing which should be quite definitely worked out in the laboratory before anyone even thought of applying it to the outside air. If he would consider the energy involved in the formation of an inch of rainfall, and the number of steamers an inch of rainfall in England would drive across the Atlantic, he would understand that no process of effecting rainfall could hope for success. Nothing that he had heard had suggested that any mode of supplying or of abstracting the necessary electricity from the atmosphere could possibly be effective. "Let us deal with the atmosphere," he said, "as we find it, before attempting to change it."

Sir Joseph Thomson congratulated Dr. Chree on his paper. Sir Oliver Lodge's suggestion was only to convert potential energy into kinetic. He had calculated there was quite a possibility, with expending a moderate amount of energy, to alter the conditions over a considerable area. The difficulty he could see was rather political than scientific. If the experiments were going to affect other countries, there would have to be some sort of treaty drawn up as to how far one might go on experimenting in this country if it turned out to be successful.

Electrification on the London, Brighton and South Coast Railway.

In the Engineering Section, Mr. Philip Dawson described the electrification of the London, Brighton and South Coast Railway, between Victoria and London Bridge Stations.

He mentioned that he was called upon to superintend the electrification of this portion of the London, Brighton and South Coast line, because of the serious competition that was being offered by the local tram services. The reason why an electric railway could compete with tramways was that a passenger was certain of getting a seat, or, at the worst, of finding standing room; if when it was wet the passengers had more comfortable waiting rooms than when they were waiting for a tramcar, and they got also higher speeds, so that, even if the fares were higher, people would always prefer an electric railway to a tramway.

In selecting the system to be adopted, the speaker pointed out that there were a great many points to be considered, amongst which were the possibility of the extension of the electrification, not only for the immediate suburban requirements to a 10 or 15 miles radius, but also up to 25 or 30 miles, whilst they had not to lose sight of the fact that 50 miles from London there was a favourite watering-place to which already was established a service of 36 trains, in each direction, per day, and that, it was not far to look to conceive the possibility of the electric service being continued as far as Brighton. Under these conditions, the system he recommended, and which had been adopted, was the single-phase system, using alternating currents at a pressure of 6,700 volts on the overhead conductors, bringing the current from the power station to the overhead conductors at a periodicity of 25 periods.

There had been objections made by engineers to the adoption of the single-phase system, it being claimed that the single-phase motor had bad acceleration, that it was much heavier, had a lower efficiency, and, therefore, a greater consumption per ton mile; that they cost more in consequence of their greater weight, incurring thereby greater cost of maintenance. The total extra weight, he argued, would never exceed 10% in a train equipped with continuous current motors. Probably it would not exceed 5%, which was a very small amount compared with the very considerable advantages that were derived from single-phase traction, whilst the amount of energy required was considerably less than the single-phase current than with the continuous current. Mr. Dawson went on to describe in detail the work that had been done, illustrating his observations by means of a large number of interesting photographs. The total length of line electrified, he said, was only 8¼ miles, but in that distance he thought they had met with all the serious difficulties that could be met with on any main line electrification.

In leading off the discussion, the President observed that Mr. Dawson's remarks had shown how completely science had taken possession of one department of railway working. If it could be possible to suddenly make everything transparent, exhibiting the leads conducting the current, passengers would find themselves in a sort of wire cage, in which these currents were surging all around, and would have brought home to them what science meant as applied to railway work.

Professor Sylvanus Thompson, F.R.S., speaking in regard to a statement by Mr. Dawson that he did not wish the discussion on his paper to degenerate into a discussion upon the relative values of alternating and continuous current, said that whatever Mr. Dawson wished, he could not help the paper being a matter of importance in that discussion. He quite agreed that no one system could be set up as being superior to every other system, in all cases, and he agreed with the idea that on short lines, or with short distances between stations, there might be considerable advantages in using the continuous current, but there had been so much prejudice against the use of the alternating current, and particularly against the use of the

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single-phase current, that he for one was particularly glad to have heard Mr. Dawson's description of this most successful installation of single-phase alternating current. They must all congratulate Mr. Dawson on the success he had made, after great pains, to prepare for all possible contingencies, and to foresee all the necessities of the case.

They had not done with the single-phase alternating current yet, by any means. Only a fortnight ago he was looking at the drawings of the largest locomotive yet to be made, one of 2,000 h.p. In this the single-phase alternating current was to be used, and probably it would not be the last or the largest use that would be made of this current. On long distance work, the obvious advantages of alternating single-phase current were so very great that it would require a very great deal of argument, and much more than argument on paper, to show that the three-phase, continuous, or any voltage whatever was of any serious superiority. Long distances would offer the problem of the future, and in their consideration the examples given by Mr. Dawson would be of very great value.

Sir W. H. White, K.C.B., thought they must all have been impressed with the marvellous way in which, in the design and execution of this work, scientific methods had been associated with the experimental, in order to secure success. Mr. Dawson had told them that they had had no trouble whatever since the line was started. As one who had had to do with experimental work to a great extent, he could only congratulate him that that had been so, in view of the difficulty and complexity of the problems he had had to face. If he might add a word, he would say that in the engineering department at the Imperial College they congratulated themselves on having, as lecturer in the railway engineering course, a gentleman who so well combined scientific knowledge and practical experience and skill in the conduct of difficult operations, as Mr. Dawson.

Electric Lamps.

In the Physics Section, Dr. Henry Sand, of the Nottingham University College, made an interesting communication relating to lamp construction. He described how he had discovered a simple method of sealing iron wire vacuum-tight into glass. First of all, an iron wire is sealed into the glass, and, while the latter is still hot, a small piece of heated steel tube surrounding the wire is pushed a little way into the glass. After cooling, the steel tube is soldered to the wire. The vacuum-tight seal is produced between the inner surface of the elastic steel tube, which on cooling becomes slightly stretched, and at the same time compresses the glass.

The possibilities of this discovery will be realised when it is remembered that up to the present time the only metal which has been sealed vacuum-tight into glass on a commercially successful scale is platinum. And so it comes about that every one of the 250 million electric lamps manufactured annually contains a minute piece of platinum which conveys the electric current into the interior of the lamp. This means that annually nearly half a ton of platinum is used in the electric lamp industry.

Platinum is one of the most expensive metals known, being actually dearer than gold, and the amount used annually for electric lamps represents a consumption of over £100,000 worth of crude platinum. The same weight of iron would cost only a few shillings, so that any process which might successfully substitute this metal for platinum would effect a saving of £100,000 yearly.

Power from Sun and Wind.

Professor Fessenden, of Hamilton, Ontario, engineering representative on the Ontario Power Commission, appointed by the Canadian Government, dealt with "The Utilisation of Solar Radiation, Wind Power and other Intermittent Natural Sources of Energy." He delivered his address *extempore*, having lost his paper. The Professor began by saying that there had been considerable talk for some time on the conservation of natural resources, but he argued, in the first place, that there was no such thing as natural resources. If wood was a natural resource, it only was so because somebody learned to chop it down and cut it into shape. If our rivers were natural resources, it was because somebody learned to build boats which would float on them. So that there was no such thing as a natural resource in the sense in which the term was being used just now. The real natural resources of any account were the organisers and discoverers—in fact, they might say that the British Association was one of the natural resources of the United Kingdom. For that reason, it might be said that iron ore was not a natural resource until somebody discovered a method of utilising it.

Professor Fessenden went on to describe experiments that were being carried out at a spot in Massachusetts, under his direction, for the purpose of utilising the heat of the sun, and the force of the wind, for the purpose of generating power. The method he described would show that in the future they might be almost independent of coal as a means of generating power. Dealing with the question of the storage of power, he explained that a storage battery would not be of very much use, as the cost in interest and depreciation would be greater than the first cost of the power, but storage was necessary, in that experiments had shown there was an absence of both wind and sun on 14 days in the year, and they had to have sufficient storage to keep things going for that length of time.

He was afraid the method he was about to describe would be disappointing in that he had adapted a simple engineering solution, based on the knowledge that a cubic yard of water, falling 1,000 ft., would yield 1 h.p. for an hour. To build a tower 1,000 ft. high, and put a tank on the top of it would be impracticable from a commercial point of view, so that instead of building a tower he had dug a hole in the ground, fixed a tank at the bottom, and by utilising the means which this gave, had found a scheme of storage that was absolutely commercial.

He spoke of the development of steam from the sun's heat radiating through glass on to a large tank of water, stating that by this means he hoped to get as much as 30,000 h.p. on a hot day, whilst from a windmill he had been able to develop power to the extent of 800 kw., either from one large windmill, or from a series of small windmills erected in such a fashion as to be always facing the wind.

"Taking the average wind velocity round the coast of Great Britain," said the Professor, "there is no question that, by working a number of large windmills at the top of the cliffs, and placing water reservoirs at the bottom, pumping the water of the sea to the top of the cliffs and letting it run down, there would be given more power than is sufficient to drive all the factories, trains, and motors of all kinds in Great Britain and Ireland, and at a considerably less cost than this is now done by steam. The cost of plant in that case would be small. You have no shafts to sink. Your sea supplies the water. You simply erect the pumps and turbines and windmills on the foreshore, and use them in whichever way you desire."

He then went on to give comparisons of cost from figures obtained during the investigations of the Ontario Power Commission. He explained that whereas the cost per horse-power for 100,000 h.p. was at Niagara 15s., steam would be £3, gas £2, and the system he suggested £1. There were very few places so favourably situated as Niagara, but he suggested his method as the best alternative, observing that the first cost, which in the case of Niagara was £9 per horse-power per hour, was by far the most formidable item, the cost of upkeep being comparatively nothing. His means of storage did not exceed 12s. per kilowatt per annum, assuming that the calculation of one fortnight per annum in which there was neither sun nor wind, was correct. The problem, therefore, of the utilisation of the earth's "natural sources," he asserted, had been absolutely solved, for, by the means he suggested, it was possible to make full use of any intermittent power, provided they could get the power out. He declared, also, that there was no question as to the commercial success of the solar method of generating heat.

He had not proposed to give any details of his scheme until it was in a more advanced state, but, he went on, "some of the enterprising newspaper men out there had got hold of the thing, and as I have suffered before from that cause, I thought it best to present the subject before a scientific body rather than have it go through the newspapers. Otherwise I would have waited until we had had a

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year's running of the plant." He had also made experiments with a view to using alcohol made from fruit instead of coal, and found that it compared favourably with the present prices of petrol.

During the discussion, Sir WILLIAM WHITE said it appeared to him that all these schemes for using intermittent power died because of their very heavy initial cost. Regarding the use of a steady flow of water, he was greatly struck by evidence given before the Parliamentary Committee dealing with the question of supplying electric power, by one engineer who had great experience of both water-power and steam plants, and it was his opinion, taking all the expense into account, that the cheapest way of generating power was not in the utilisation of natural forces, for the reason that the initial cost was so high, and that it was better to use fuel. He had not a word to say against Professor Fessenden's proposals, but it appeared to him that his estimates, however carefully they might have been prepared, must be received with some caution. His experience was that in all schemes of this kind—in all cases where schemes of an original character were put forward, the natural tendency was to frame the estimates on a somewhat hopeful basis, and that when the scheme came to be actually applied the figures were found to have been on the low side. He had never known any invention of a naval character that did not tend that way.

Professor W. E. DALBY (the President of the Section) asked whether Professor Fessenden had considered the cost of transmitting the energy from the coast to the interior of the country. Would it be cheaper, for instance, for Messrs. John Brown & Company in Sheffield to get their power from a windmill at the coast rather than burn fuel from the coal-pit, which was on their own door.

Professor COKER observed that in Denmark, which was understood to be situated most favourably for the use of wind power, they found thousands of small windmills of two or three horse-power, but they never saw a large windmill. He did not know why that should be so, if it were possible to obtain large units of power from windmills.

Professor FESSENDEN replied to the discussion, observing that he had really tried to be conservative in his estimates. The actual contracts for the work at Niagara came out at half a million dollars under his estimate. He had dealt with these estimates in the same generous fashion. Replying to the question put by the President, Professor Fessenden declared that power could be produced at the coast, and delivered to Messrs. Brown & Company's works in Sheffield at a cost considerably less than it could be produced from coal on their own works. He had no hesitation whatever in saying that.

ENGINEERING WORKS ELECTRICAL EQUIPMENT.

The Society of Engineers (Incorporated), last week visited the works of the Thames Iron Works, Shipbuilding & Engineering Company, at Canning Town, E. These works, which cover an area of 26 acres, include shipbuilding, civil engineering, electrical engineering and dry dock departments, and are equipped with tools and plant ranging from those of the heaviest description used in the construction of battleships and massive constructional work down to the smallest of automatic tools for the making of electrical fittings and switch parts. The electrical engineering department has its main shops in the same building as the general offices, and has a large output of general electrical work. The central station, situated nearer the middle of the yard, is equipped with a 250 kw. motor transforemr, set for converting the Borough Council supply at 500 volts to 220 volts, to suit the yard service. Independent stand-by sets, capable of supplying the power and lighting for the yard in case of failure of the Council service, are also installed, and a battery of powerful air compressors will be seen for the supply of power to the numerous pneumatic tools in use.

LIENS REGISTERED.

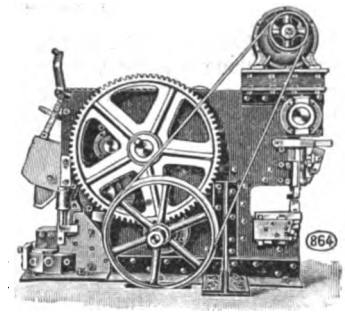
ELECTRICAL APPARATUS COMPANY.—Satisfaction in full on August 19, 1910, of Debentures dated October 27, 1909, securing £500.

THE ENGINEERING AND MACHINERY EXHIBITION.

The Naval, Mercantile Marine, and General Engineering and Machinery Exhibition at Olympia, which has been opened for a week, and remains open until the 26th, has attracted very good attendance, a number of engineering societies having organised special visits. Several meetings are to take place. Naval engineers are to muster in force, and Mr. W. P. Durtnall will lecture on the electric drive for ship propulsion, and will, we understand, bring forward some important new points. When the Association of Engineers in Charge visit the exhibition, on Thursday, 24th, Mr. G. Langler-Bullocke will, by special permission of Mr. Marconi, lecture on "Wireless Telegraphy and its Maritime Importance."

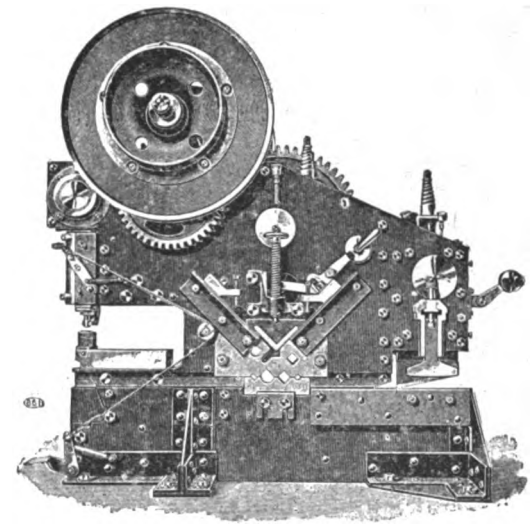
As mentioned in our last issue, the exhibits are varied and of great importance, electricity coming in for a fair share of attention. We now give a brief review of certain of the stands appealing more particularly to our readers, referring specially to engineering exhibits driven by electricity.

A good illustration of this is seen on the stand of Henry Pels & Company, who show various types of John's patent combined punching, shearing and cropping machines, for dealing with rails, joists, etc., worked by electric motors and controlled by Adams' "Igranic" control. It is al-



JOHN'S SHEARER AND CROPPER, ELECTRICALLY DRIVEN.

together a most effective illustration of co-operation, the machines cutting through iron or steel rounds or squares, punching holes with the greatest ease, turning out clean work, and also being under perfect control. The exhibit



JOHN'S SHEARER AND CROPPER—SECTION.

certainly demonstrates the utility of a John's machine in a tramway repairing shop. On the stand of Brown & Wade, Ltd., an electrically-driven compressor may be seen at work.

Then on the Worthington Pump Company's stand we find four pumps being driven by electric motors. There is a splendid exhibit of a 1,600 square feet Worthington surface condenser, with electrically-driven centrifugal circulating and hot water pumps, and Worthington rotary air pump, which is worthy the attention of any central station engineer. The power here is supplied by a motor of the Lancashire Dynamo Company, Ltd. Then we see a 1½in.

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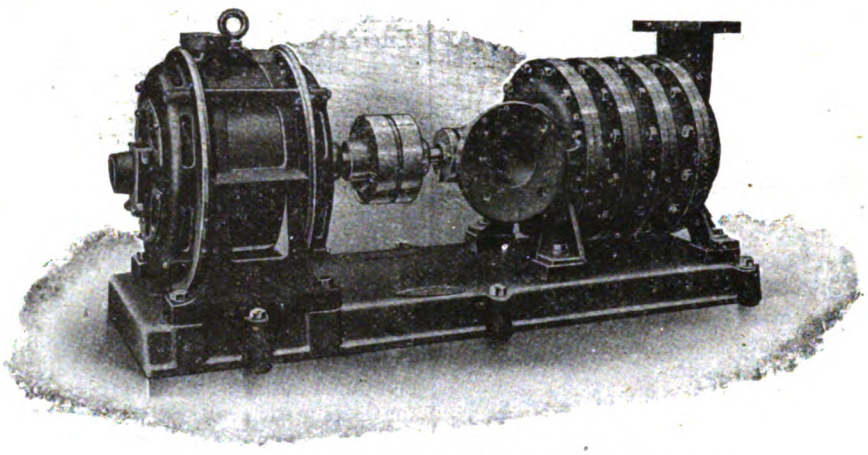
three-stage and a 1 in. single-stage centrifugal house tank pump, and a $4\frac{3}{4}$ in. by $4\frac{3}{4}$ in. vertical air compressor, all driven by electricity, the motors being supplied by Verity, Ltd. The smooth working is most striking.

The demonstration is carried a step further, for one of the tanks is provided with a weir, and a pipe connects this with a Lea patent combined indicating, recording and integrating instrument, and the whole process of measuring the discharge from the pumps is shown. Besides this convincing exhibit the Lea Recorder Company also show a Lea's patent self-contained recording set, which comprises a 6 in. recorder, float chamber and notch tank. This set can be used for measuring widely varying flows with an instrument, that is, by substituting different notches and weirs of varying width. In this case, too, we have a practical demonstration, the small pump being driven by an electric motor. Other forms of the indispensable Lea recorders, working parts and photographs are to be seen.

The Adams Watkin Company, Ltd., show their switches controlling the supply of current to ranges of glow lamps, ventilating fans, heating apparatus, and a small motor driving a sewing machine. In this manner the ease with which the switch regulates the supply of electricity consumed for lighting, heating and power is brought home to the general public.

The Cambridge Scientific Instrument Company have a fine collection of apparatus on view. The electrical instruments include a Duddell oscillograph, Ayrton-Mather galvanometer, Duddell thermo-ammeter, Grassot fluxmeter and Weston standard cell. There are also several pyrometers, including an electrical resistance instrument and different types of thermo-electric appliances.

J. Marse & Company show a "Piat" hydro-electric rivetting machine. This is a portable type of machine, weighing 14 cw. The electric power is, of course, obtained externally, otherwise it is completely self-contained, and therefore easy to transport and handle. It will close 340 $\frac{7}{8}$ in. rivets within an hour when driven by a $2\frac{1}{2}$ h.p. motor. It is automatic, and requires only a very small amount of water, which can be replaced when working in very cold temperatures by some form of non-freezing liquor. The firm also show a very simple appliance, the "Jost" high-speed drilling machine, which is capable of drilling an inch hole in mild steel one inch thick in 28 secs. under ordinary driving power.



Worthington Electrically Driven Air Compressor.

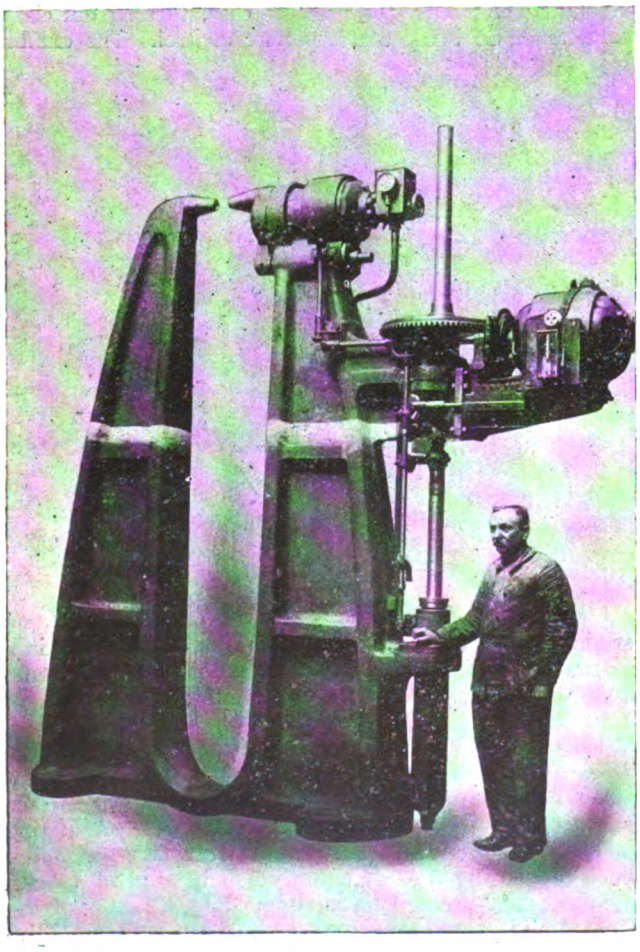
Wallack Bros., Ltd., also show an effective electric drilling machine at work. Its simplicity and efficiency should appeal to central station and tramway engineers. On this stand good types of those very necessary aids to smooth running and economy, oil tanks and oil filters, are shown.

The Britannia Engineering Company (1910), Ltd., are to be congratulated on their very workmanlike 10 h.p. vertical high speed electric lighting set, the splendid little engine using paraffin as fuel. Several types of automatic safety oil, petrol and alcohol engines are also displayed.

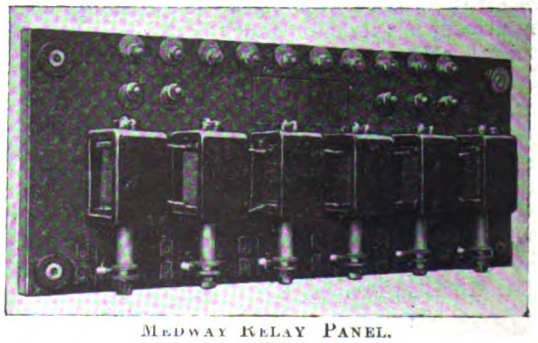
Electric clocks and recorders are shown both by Stockall, Marples & Company, Ltd., and the Synchronome Company.

An attractive display is made by Chadburn's (Ship) Telegraph Company, an astonishing variety of apparatus for telegraphing from the bridge to different parts of the ship being shown in action. Among these is an electric telegraph system designed specially for working two boiler runs in two large liners now under construction.

Medway's Safety Light Company show a beautiful little model of an electric lift, and also one travelling up to the gallery. The latter is driven by a 10 h.p. British Thomson-Houston motor, built to the Medway specification, which provides for an auxiliary field winding connected in parallel with the armature resistance, by which means an additional starting torque is obtained. This motor is direct-coupled to a self-sustaining worm reducing gear, driving the lift by means of a V grooved



"Piat" Hydro-Electric Rivetter, Fixed Type, Gap up to 24 ft.



Medway Relay Panel.

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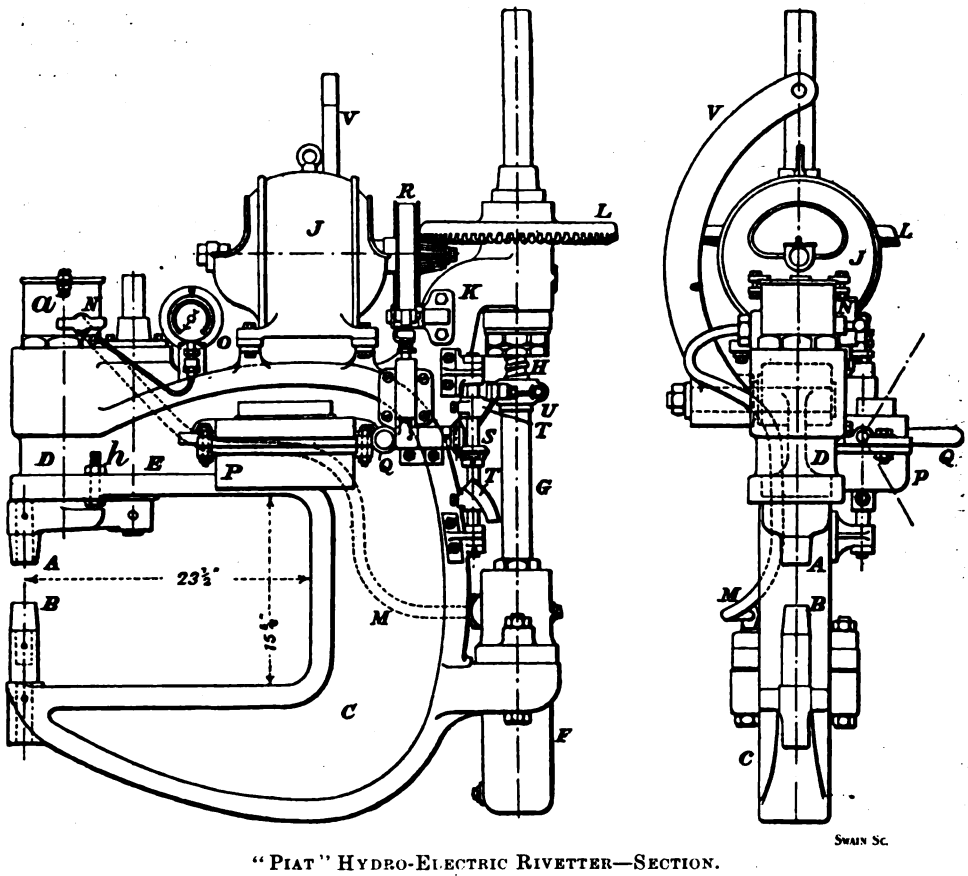


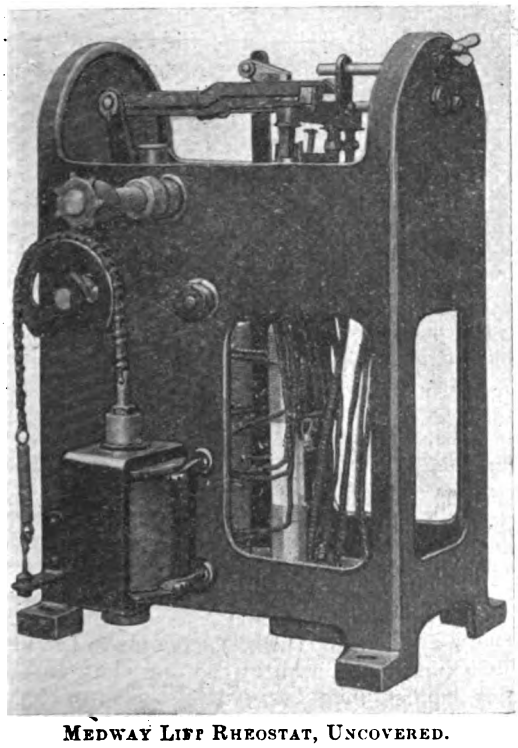
"Piat" Hydro-Electric Rivetter—Section.

wire rope driving wheel. The lift can be controlled by pushes on the landing or switches on the car, while powerful electro-magnetic brakes are provided. This firm make a speciality of electrical controlling apparatus, samples of which are exhibited.

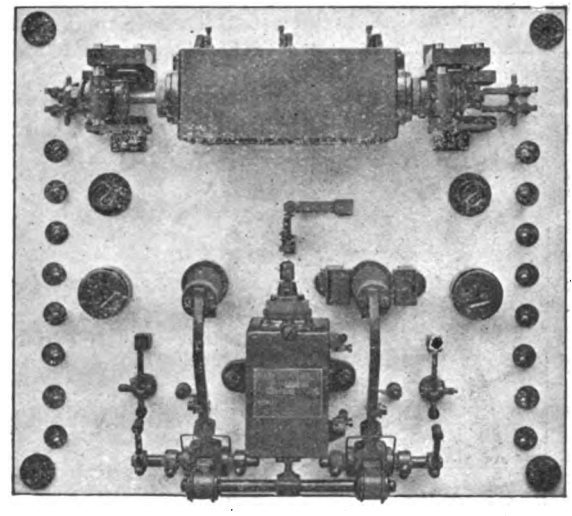
shown at work in an annexe. Another money-saving device is represented by a model of the Lassen and Hjort water purifier.

E. S. Hindley & Sons show three engines: a 756 h.p. vertical three cylinder gas engine for direct coupling to electric generator, centrifugal pump, etc.; a 11in. by 6in. enclosed vertical high speed steam engine; and a 6 in. by 6 in. open type high speed steam engine. These are all characterised by compactness, simplicity of design, and high grade workmanship. When examining these it is just as well to step over and inspect the boiler fronts fitted by the Economic Forced Draught and Engineering Company, Ltd. These fronts are designed not only with a view to provide forced draught, but, while giving an increased sized door, to prevent undue radiation.

Ingenious telescopic portable scaffold towers, ladders and trestles are shown in satisfying variety by Heathman & Company. Certainly these appliances are most useful, being cheap and economising labour. They are both well designed and carefully built. Equally deserving of attention are the firm's fire-lighting appliances.



Medway Lift Rheostat, Uncovered.



Medway Lift Car Switch Controller.

Germane to the above class of apparatus are those shown by Pickerings, Ltd., who have a comprehensive display of hoists, fitted with their well-known differential sustaining blocks. One of these hoists is a direct-coupled electric friction type, with motor and starter complete.

Babcock & Wilcox, Ltd., have a number of boilers on view, as well as a model of their labour and money saving patent mechanical chain grate stokers. It may be mentioned that in many recent reports from electrical engineers we find central station losses converted to gains, or profits largely increased as the result of introducing mechanical stoking. A portable type of their water-tube boilers is

C. W. Burton, Griffiths & Co. bring before visitors an array of tube, boiler and engineers' tools, many of which can be worked advantageously by electricity. For instance, the tube expander and driller, which, driven by electricity, can be managed easily by one man. Then there is the "Wickstead" flexible shaft which, with appropriate tools, can be used for drilling, cutting and so on. Tube expanders are shown in the ordinary Dudgeon pattern and the newer Thompson type. Other tools comprise internal tube cutters (including a new single roll cutter, which is strong, but will not turn tubes outside the tube plate), tube beaders, tube recessers, tube stretchers, and tube extractors. A

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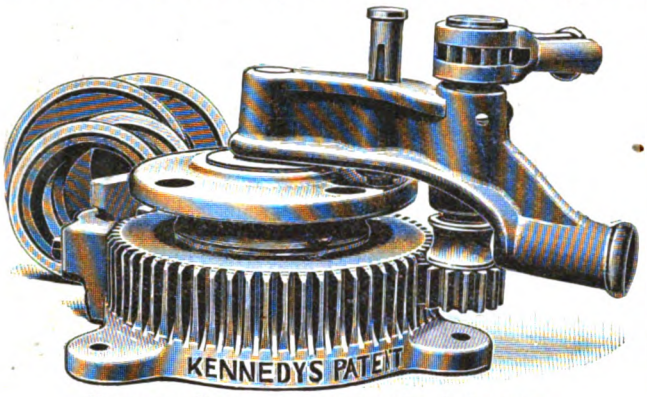
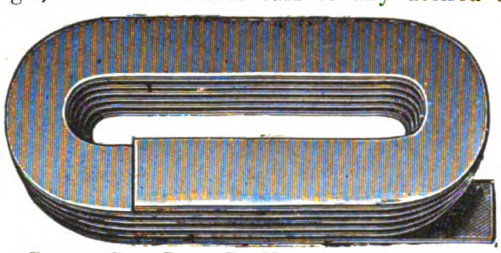
patent tube cleaning head suitable for most water tube boilers is a remarkably useful appliance.

Different patterns of the "Kennedy" patent bending machine, with specimen tubes, round and flat bars bent by the machine are shown by John Barker & Company, Ltd.



KENNEDY BENDING MACHINE, NO. 2. GEARED.

The machines are quite simple, and with very little expenditure of force will bend copper, brass, iron or other metal welded, butt jointed and seamless tubes, round, flat, angle, tee and channel bars to any desired extent.



COPPER COIL BENT BY KENNEDY MACHINE.

A strong adjustable top plate prevents all bulging and thickening during the process of bending. Wonderful results can be obtained with rails and girders, tubes and conduits. The compactness and portability of even the most powerful machines are much in their favour.

Richard Klinger & Company show "Klingerit" jointing material, stuffing box packing, and a cheaper substitute for "Klingerite," all high-class and effective devices for economising steam and preventing leakages and bursts.

FIG. 1.

FIG. 1. KLINGER'S IMPROVED GAUGE COCKS (SIDE VIEW), WITH ORDINARY GLASS GAUGE TUBE

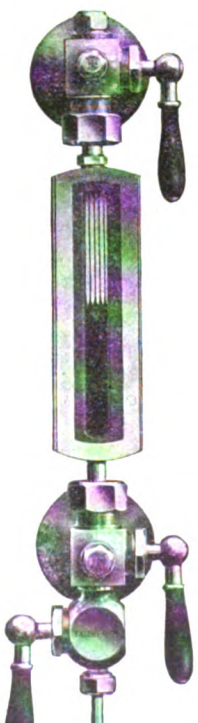


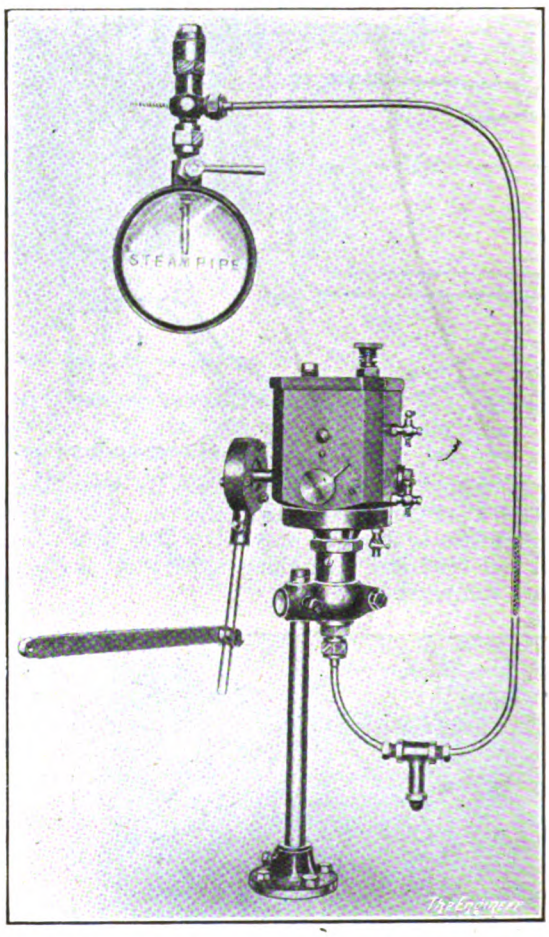
FIG. 2.

FIG. 2. SHOWING KLINGER'S "ATTACHABLE" PATTERN GAUGE FITTED IN KLINGER'S IMPROVED GAUGE COCKS.

Another economising and safety device is the "Klinger" gauge. It is a fine piece of mechanism, providing a plain water level indicator, strong and safe water gauge, and doing away with the necessity for stuffing boxes.

The Combination Metallic Packing Company, Ltd., use metallic packing for engines, turbines and pumps, varying the type for the different classes of work. But in all cases, it is claimed, the packing lasts for years without requiring attention, and will not heat up, mark, or wear the rods. For special purposes they provide metal jointing rings, which are safe and long lived.

Lubricants are well to the fore. The Graphite Products, Ltd., show Dixon's pure flake graphite, mixed with oils or greases, and which, being unaffected by heat, cold or acids, adds enormously to the economy and safety of ordinary lubrication. These properties also make graphite an ideal material for preparing pipe joint compounds, which are far superior to red lead. An ingenious contrivance for applying these lubricants is the "K & W" graphite



cylinder lubricator shown herewith. The apparatus can be used both with a mixture of graphite and oil, and without oil. A Knowles and Wollaston graphite cylinder lubricator is shown at work. Price's Patent Candle Company, Ltd., show a great number of forms of lubricants, among these being special water and acid free lubricants for dynamos and electric motors and also good types for steam engines, steam and water turbines, cylinders and valves. Being bye-products of the company, they are able to combine high grade with moderate prices.

Before closing this notice, we would say a word or two about the "Montague" office fittings, shown by the manufacturers, Hammond & Stow, Ltd. These aids to the busy worker include fumed oak, white wood and cloth covered filing cabinets, built up in sections, and designed to receive card indexes, letters and papers of various sizes. They are all strongly made and remarkably cheap. Some of the combination cabinets include letter files, storage cases for documents, catalogues, index cards, with appropriate stands, section with pull-out slab, forming a desk whereon papers can be placed while consulting the files, stationery receptacles, etc. These can be built up and extended as growth of business demands. Very useful, too, are the vertical letter files, which engineers can use in a way to keep papers connected with one job together. These cost from 1s. 9d. to 3s. Folders for receiving papers and letters are made up in all kinds of forms to suit individual needs. The clever designing, excellence of material used and good workmanship should assure this firm of office requisite makers a welcome wherever labour-saving appliances are appreciated.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

One of the most important developments in the Tyneside industries which has taken place within recent years is the acquisition by Messrs. W. G. Armstrong, Whitworth & Company, Ltd., of about 55 acres of land at Walker on a long-term lease. The object of this development is to give ample room for the below-bridge shipbuilding enterprise of the firm, which will avoid taking the large battleships now built by the firm through the narrow channels of the swing-bridge. Added to this, the firm will now possess a river frontage of nearly a mile at a part of the river which is of ample width to ensure the easy launching of the largest vessel. When the Walker shipyard is complete it is probable that no other shipbuilding firm in the world will be able to offer such ample facilities for building ships of war. The opportunity which exists for electrical and other manufacturers for the sale of their specialities for the equipment of these immense works can be judged by the fact that £200,000 will be required to effect the initial clearing of the ground before building operations can be commenced.

A Suggested Telpher System.

Apropos of this development, a somewhat interesting problem arises—How to dispose of some very large ballast hills at Walker which must be cleared before the shipyards can be laid down. It is suggested in the "North Mail" that material which is superfluous at Walker would be acceptable in filling in the Ouseburn Valley, and it is suggested that the electric tramway service, with suitable sidings might be utilised to convey the material by night. An alternative scheme to this has also been mooted—a telpher system and overhead transporter—but it almost appears that the cost would be too great.

Newcastle Tramways.

The annual report on the Newcastle Tramways undertaking which has just been issued by Mr. E. Hatton, the general manager, is most encouraging reading. The gross profit during the last year, neglecting depreciation and sinking fund, is £209,676. The average cost per passenger is 0·63 pence, while the average receipts per passenger is 1·096 pence. The surplus on the undertaking, compared with last year, is nearly doubled, and this has certainly not been at any expense of efficiency, as the whole system has been most thoroughly maintained. In the meantime, the question of extension, by trackless trolley as well as by permanent way, is still to the fore. The Newburn Urban District Council last week discussed in detail the extension scheme, and the question of putting the roads into proper condition for receiving tramway rails and withstanding the heavy traffic was carefully discussed.

The County of Durham Electricity Supply.

Electricity supply in the County of Durham is at present making great progress. At South Hylton the County of Durham Electric Power Distribution Company, Ltd., is extending its sub-station in the village to a capacity of 2,800 h.p., the supply being obtained from the 20,000 volt trunk mains from Carville and transformed down by means of Brown Boveri static transformers. At Easington a new sub-station for a local distribution at 3,000 volts has been installed, the capacity being 1,100 kw. This is partly for the purpose of supplying the Easington pit Reyrolle high-tension gear and Electrical Company's transformers are to be used. There are also important extensions in progress at Hesledon, Boldon and Washington.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The Birmingham Municipal Supply is gaining a large number of new customers, especially among the smaller manufacturers and in other directions where small motors are in request. The Department is as busy as it can be in this kind of business, while lighting connections are also rapidly increasing in number. The showroom opened at the Dale End offices is now fairly complete in its representative exhibits. Among the recent additions are a pair of shears supplied by Hands & Son, Birmingham, and driven by a No. 1 Siemens 3 h.p. squirrel-cage motor with an Ellison starter; and a Roots' blower, supplied by Thwaites Brothers, Ltd., of Bradford, and driven by a 1¾ h.p. Phœnix motor with a starter by Donovan & Company, of Birmingham, and an "E. P." controller specially designed by the makers of the blower for the automatic regulator of electric motors when driving machines of this kind. The principle of this controller is that when the pressure produced by the machine increases, resistance is cut out of the field circuit of the motor so that a reduction of speed occurs, and if the pressure decreases the speed of the motor is automatically increased. There is also in the showroom a bench fitted with a G.E.C. bench drill with ⅛ h.p. motor and a double ended spindle driven by a 1 h.p. G.E.C. motor and having at one end a polishing mop and at the other a scratch brush, this being a form of apparatus for which electrical power is likely to be in great demand in the city. Other illustrations of the manufacturing uses of electrical power will shortly be added, among them a model rolling mill.

School Signal Bells.

It is rather curious to find one of the earliest and most promptly and generally adopted applications of electricity to the common convenience, namely, the ordinary electric "tingler," meeting with opposition especially from educational authorities. This occurred, however, at a recent meeting of the Kings Norton Education Committee. It was proposed to install a set of electric bells in each of the three departments of some new schools now being erected at King's Heath. The suggestion came from the architect, the idea being that the bells would enable the head teacher to notify changes of lessons and playtime and to summon teachers. The bells, it was suggested, might also be made to serve the purpose of a fire alarm. The chief opponent to the proposal was Mr. Frank Roscoe, who, besides being a member of this local authority, is Principal of the Day Training College for Men Teachers in the Birmingham University. Mr. Roscoe said that though bells were in use in some of the Birmingham schools, he did not favour them. He thought it desirable to encourage the visitation of the classrooms by the head teacher rather than to render it easier for that officer not to visit them. As far as indicating playtime and changes of lessons went, a very good set of clocks could be got for the money, while as a fire alarm he thought a whistle was better than a bell. Mr. Roscoe's arguments appeared to meet with approval, for by a substantial majority the committee decided to dispense with the bells.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

Once more Lancashire is threatened with a great cotton trade lock-out. This time it all arises through one man—a grinder in an Oldham mill—refusing to do work which his Union did not allow grinders to do. On his being discharged, the Union supported him by calling a strike at the mill,

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which has as a result been shut for three months. Arbitration having been refused, the Employers' Federation have now decided to bring about a general lock-out until the difference is settled, and the whole point on which it depends decided once and for all. Naturally, the owners feel entitled to decide how their works shall be conducted; the men stick to their trade union regulations. Obviously both sides must have their rules to work to, but it does seem that these need not clash with one another. The spirit of conciliation appears to have quite broken down in labour matters just at present, and both employers and employed seem to be just spoiling for a good fight. The workers feel stronger than ever, and are consequently not disposed to yield an inch. The ultimate result of this continual strife can only be to make co-operative ownership by master and men, or some form of profit sharing, the general rule. When this comes, English industry will feel the better for it. For the present, in spite of the continuous strikes which have attended it from the very beginning, the principle of collective bargaining as between associations of employers and employed certainly makes for simplicity, and by fixing rates of wages for definite work gives stability to the condition of the industry and removes to a very great extent what would otherwise be a most variable factor and the easiest to manipulate in under-cutting in the market. If the lock-out comes, it will seriously upset the whole engineering trade in the county; prosperity in other parts may counterbalance this somewhat, but it would be very unfortunate if when the industrial prospects are improving labour troubles should spoil them.

Trade Union for Electrical Engineers?

It can only be a matter of time before someone, willing to risk his "job," starts a trade union for overworked and underpaid electrical technical men. The idea has often been suggested in Manchester, as elsewhere, but so far nothing has been done, yet the tendency is ever towards crowding out the lower ranks of electrical engineering with men amply qualified for much higher positions, which unfortunately do not exist. The result is that as the training improves the salaries decrease. This would be very good for the country if the extra training were turned to account, but again, thanks to want of openings, it is not. It has been suggested that the I.E.E. might look into the matter, but this is hardly possible; the I.E.E. is more a craft guild than an embryo trade union. If any step ever is taken, it will have to be taken by a separate society. When the "Electrical Engineers' Union" is an accomplished fact, there need be no antagonism between its members and the heads of the firms; it would be run on broader and more enlightened lines than the ordinary union can be expected to follow.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The third international radiographic conference will be held here in the spring of next year. Invitations have been already issued to all countries which participated in the last conference in 1906. Radiography has made such progress since that date that many important questions will have to be considered by the coming conference that had not arisen in 1906.

New Cable from Emden to Monrovia.

Some interesting details are to hand about this cable, of which some account was given in this column early this year. The execution of the work was confided by the owners of the cable, the Deutsche-Sudamerkanische Telegraphengesellschaft to the Norddeutsche Seekabelwerke. One thousand eight hundred and fifty-seven knots of submarine cable and four knots of land cable weighing altogether 3,408 tons, were shipped between January 18 and February 16 of the present year on board the Stephan. The steamer left Nordenham on February 21 at Teneriffe, already connected with Emden by submarine cable. The steamer left Teneriffe for Monrovia on March 5, and the land connections were completed there on March 19. The greatest amount of cable laid in one day was 196½ knots. The total length of cable from Emden to Monrovia is about 3,337 km. (2,070 miles), and the greatest depth at which it is laid is 2,400 fathoms. The makers of this cable are now engaged in making another to continue the direct line from Emden across the Atlantic to Pernambuco.

New Wireless Station.

A new radiographic station was thrown open for public use on July 20 at Sebenico, a port on the eastern side of the Adriatic, about 130 miles south of Pola. The radius of action of the Sebenico station is about 350 miles. For radiograms to be sent from this station to vessels at sea, the charge to the general public is 60 hellers, say 6d. a word, for messages handed in at this station.

Wireless Time Signalling at Norddeich.

The arrangements for wireless time signalling from Norddeich to ships are now complete, and in operation. Two signals are sent daily, one at noon, the other at midnight, G.M.T., or one at 1 p.m., the other at 1 a.m., to conform with central European time-keeping. A ship receiving this signal can correct its chronometers or find the longitude without a chronometer. For this purpose Norddeich gives for 2 min. continuously beginning at 11.53 a.m. the signal . . . — so that the ship can time its apparatus to Norddeich pitch. Two special signals follow, one at 11 hours 57 min. 47 sec., the other at 11 hours 58 min. 38 sec. Then follow the actual time signals, beginning at 11 hours 58 min. 46 sec., and repeated every second up to 11 hours 59 min., and then every second from 11 hours 59 min. 56 sec. to 12 hours. The system seems complicated at first sight, but there is no real difficulty about it, and the time of the operator is only taken up for a few minutes. The punctual emission of the signals is secured by having a clock regulated electrically by current from the observatory at Wilhelmshaven and sending the signals itself automatically.

Germany and the Turin Exhibition.

The German Committee dealing with the Turin Exhibition of International Industry and Commerce reports that out of 3,500 sq. metres of floor space 3,200 sq. metres have already been taken up by German exhibitors. The Italian authorities have consented to increase the 300 sq. metres still available for German exhibitors to 1,000, with the intimation, however, that no more will be allowed. In the electric section the committee secured 1,000 sq. metres, and have let 700. Here, again, additional space has been allotted, so that the committee has still 800 sq. metres at disposal. Of the German Palace of Industry, which covers 10,000 sq. metres, 3,000 have so far been taken up. Hence Germany has a splendid opportunity of competing with foreign nations, especially England and France, which are developing enormous activity at the present time.

Electrification of Calico Printing Works.

At the meeting of the German Union of Chemical Colourists at Frankfort, Herr Kühl, of the Siemens-Shuckert Werke, gave an interesting address on this subject. He confined himself, however, to machinery that required direct driving. In this case the consumption of steam is enormous, and yet the efficiency co-efficient is very small. With dynamos, on the other hand, the co-efficient averages 92%, and with electromotors 85%, and only one-third of the steam required for direct drive with a steam engine is required to do the same work through an electromotor. No steam pipes are wanted except in the main engine house, and much space is saved. The speed can be regulated more easily and within wider limits when the drive is electric and without waste of power.

Fuse Out Plugs.

The details of the investigations on which an important conclusion arrived at by the general meeting of the Vereinigung der Elektrizitatswerke held at Nurnberg in 1909 have now been published in the "E.T.Z." The decision was in favour of screw plugs in two parts, with a thick walled cartridge and a screw head. This decision was confirmed at

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this year's general meeting of the Union held at Christiania. Further investigations have, however, been made with the result that a third confirmation of the superiority of this sort of plug has been obtained.

Submarine Cables.

The "Tageszeitung" publishes a long article on the extension of submarine telegraphy during the decade 1899–1908, of which the following is a brief *resume*. Countries having cables have added to them considerably, but many countries, practically dependent for their commercial existence upon submarine telegraphs, as yet own none, or next to none. The list is surprising. Norway, Sweden, Russia, Portugal, Greece, Belgium, Brazil, Argentina, China, Chili, and Mexico own between them 6,275 km. of submarine cable. Japan alone has 7,170 km. The following table gives the increase in km. for the countries named:

	Private cables.	Government cables.
Great Britain ..	37,803 ..	14,000
United States ..	33,490 ..	nil
Germany ..	22,539 ..	1,535
France	7,049 ..	9,439
Japan	No private cables ..	4,473
Holland	" " " ..	3,742
Denmark ..	2,513 ..	—
Spain	No private cables ..	313
Italy	" " " ..	72

Denmark shows a falling off in the Government cables from 436 km. in 1898 to 210 only in 1908. During the same period the private cables grew from 12,952 to 15,465 km.

Increase of Wireless Telegraphy.

The Berne International Bureau of Telegraphs reports that in February, 1910, there were over 1,000 wireless stations, of which Great Britain possessed 311, Germany 279, France 167, Italy 38, Holland 36, Sweden 27, Austria and Brazil 23 each, Denmark 21, Japan and Norway 17 each, Russia 13, Belgium 11, Chili 10, Spain 7, Roumania 6, Portugal 5, Mexico and West Indies 4 each, Urugnay 2, Gibraltar and Malta one each. The Telefunken system is employed at 327 stations, the Marconi at 233, the Lodge at 15, and the Rochfort at 4. Three hundred and ninety-eight are returned as unknown or various. The return is all right as far as it goes, but it is obviously incomplete, as it omits the United States and Canada entirely.

Company Affairs.

A new company has been formed at Kulkwitz, near Leipzig, under the name of Landkraftwerke Leipzig Aktiengesellschaft, in Kulkwitz. The capital is 5 million marks in 5,000 thousand mark shares, and the object is to make and use electrical current, especially for power and lighting. Several existing concerns are absorbed in the new company.

The C. Lorenz Aktiengesellschaft of Berlin was established as recently as the autumn of 1906. The chief business done is in telegraphs, telephones, and signalling. The capital is only £70,000, but the dividend was 10% for 1906, 12% for 1907, and 16% for 1908 and 1909. Most of the profit is derived from the Berlin factory. The Russian branch has not yet been successful. The business has now been converted into a limited company, the K. Lorenz, A.G. The main company has been very prosperous throughout the current year, and the dividend will again be at least 16%. The shares are quoted at 14% premium. For a small recently established company this cannot be regarded otherwise than as a satisfactory state of affairs.

The Hartmann & Braun Aktien Gesellschaft, of Frankfort, had a bad year in 1909, owing partly to the deprecatory effect of general bad trade on the sale of measuring instruments, but still more to the competition of larger firms. The net profit was 270,309 marks (483,895 for 1908), and the dividend falls from 11% to 8%, the carry over from 32,396 to 33,291 marks. The capital has lessened by 20,000 marks of debentures, and is now 2,320,000 marks, 1,700,000 in shares and 620,000 in debentures.

The Cologne firm of Meirowsky & Company, makers of insulating materials for electrical purposes, has been converted into a limited company with a capital of 2 million marks divided into 1,000 mark shares. The name will be Meirowsky & Company, Aktiengesellschaft, Cöln. The vendor, Max Meirowsky, receives 2,033,635 marks, 1,996,000 in shares and 37,635 marks in cash. The first board consists of Leo Meirowsky, of Giridih, British India, Dr. Enil Meirowsky, of Cologne, and Dr. Otto Strack, of Cologne.

A company for selling Pope lamps has been established at Aachen (Aix) under the title of Deutsche Pope Lampen Aktiengesellschaft, Aachen. The capital is 700,000 marks in 700 thousand mark shares, of which 400 are preference shares, and receive 5%. The others get what is left, if anything. The Chairman is Dr. Karl Trensen, of Venlo, where the Popes Metall-Gluhlampenfabrik firm does business.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The steady growth on this side of the Atlantic of the electric vehicle business stands out in bold contrast with the curious conservatism in this matter which appears still to prevail in England. Judging from reports to hand of a recent discussion on this subject in the Old Country, the later developments of American storage batteries are regarded with a cold scepticism which is wholly unwarranted by the facts, and thus a splendid source of revenue to central stations is being neglected. In the current number of the Chicago "Electrical Review" there is a short editorial on the subject of the electric vehicle which puts the point in a very striking way. When it is considered, says the "Review," that as a current consumer, an ordinary electric pleasure vehicle gives the same gross income as three ordinary residences, while a 1,000-lb. delivery wagon equals 13 residences in point of revenue, with the advantage that the vehicle load is seldom, if ever, on the peak, the statement that the electric vehicle is the best undeveloped, prospective load for the central station to-day, seems to be well founded. "The introduction of electric vehicles is slow work, but not difficult, and once a start is made, the business grows almost of itself. The start is always hard, and for a good reason—the public, generally, is ignorant of the present status of electric vehicles. It does not realise that to-day these cars are more dependable, just as sturdy, and fool-proof to a much greater extent than any other means of city or suburban transportation. The first step toward promoting the use of electric cars in any locality should be their adoption by the central station itself, just as the first step in an electric sign campaign is the erection of a sign over the central station office. The people look to the central station to take the initiative. The next point is the establishment of at least an advisory engineering department or vehicle inspection department which will supervise, to some extent, the management of electric cars within the company's territory. Whether or not the central station should maintain a garage for public use is optional, but the inspection and advisory work are absolutely essential. It is the duty of the company, desiring electric-vehicle business, to co-operate with public garages and electric vehicle and storage battery manufacturers, who are always willing to give every assistance desired. If a central station establishes an automobile department, in the hands of men thoroughly acquainted with the work they are doing, and then demonstrates to the public what the electric vehicle will do when properly applied and intelligently cared for, the results should more than justify the expense and effort."

Metal Filaments and Flat Rates.

The recent convention of the Michigan Electrical Association at Port Huron held an exhaustive discussion on the subject of rates in connection with the later developments of the metal filament lamp. The problem was how, with tungsten lamps of 16 to 25 watts consumption, a rate may be made high enough to protect the company and at the same time low enough to attract, and retain, the small consumer. Commenting on the discussion, the "Electrical World" observes that it has been frequently proposed that

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rates be readjusted in anticipation of the menace of low-candle-power tungsten lamps so as to require higher fixed charges per consumer and per kilowatt of maximum demand, at the same time lowering the kw.-hour rate. It is but a short step from this with small residences to wiping out the kw.-hour rate altogether and basing the charge on maximum demand entirely, the latter being, of course, the controlled flat-rate system. The questoin thus set for companies to decide is whether the flat-rate system will not be sufficiently accurate for the class of small residence consumers from whose business companies fear loss of revenue with the introduction of low-candle-power tungsten lamps. As far as the larger consumers are concerned, the use of heating appliances and the more liberal use of light and motors will doubtless counteract any bad effect on the revenue. In passing it may be remarked that the entry into the field of low-candle-power tungstens has plainly aggravated a situation which was being satisfactorily settled on the basis of "more illumination for the same money." It has been well demonstrated that the old-fashioned flat-rate system is not satisfactory or equitable for general application over a central-station company's entire system, because it ignores the variable kw.-hour expenses. On the other hand, the uniform meter rate of so much per kw.-hour, which originally took its place, is unfair and unsatisfactory because it ignores the element of fixed charges which are dependent on the size of the consumer's installation and the number of hours per year he uses it. It would appear that the coming successful system of rates must take into account both these elements.

Enamelling by Electric Heat.

An interesting paper on the use of electricity in baking enamel was read at the recent convention of the Michigan Electrical Association by Mr. John Cavanaugh in connection with experiments made by the Baker-Vawter Company in the construction of electrically-heated enamelling ovens. At the outset five ovens, each 5 by 7 by 9 ft. were built with triple walls inclosing a double air space for heat insulation. Various types of heating coils placed at different portions of the oven walls were tried. After a series of trials it was found that with four coils in use it was possible to raise the temperature to 250° F. in one hour; this had to be maintained practically four hours, which required the expenditure of 16·8 kw.-hours. A later type of oven was built with dimensions 6·5 by 8 by 8·5 ft. and having triple hardwood walls with asbestos paper between the layers of boards and a ½ in. lining of asbestos. Both inside and outside the oven was covered with polished tin. Four heating coils were used and the temperature was raised to 210° in one hour; it was maintained there, however, with the use of two coils only, and the energy consumption for the entire baking was 16·2 kw.-hours, only about one-third as much as in the former ovens. Six ovens are installed, at least three being in operation. They are fed with 110-volt current from a three-phase circuit, two adjacent ovens being on the same phase and one baking while the other is being emptied and refilled. The energy for this service is supplied at 2½ cents per kw.-hour.

Machine Tools and Individual Drive.

Discussing the manifold advantages of using individual motors for driving machine tools in electric railway repair shops, the "Electric Railway Journal" arrives at the conclusion that although the comparatively high first cost of a number of individual motors as compared with one or two large motors driving shafting is often regarded as an important consideration, the day is not far distant when a change will be made in favour of individual drive. As every means of forcing the output of an electric railway repair shop must be considered there is coming to be a better appreciation of the inefficiency of shafting and belt driving. "A test of the power required to run even a small shop using overhead shafting usually will show that more current is consumed in turning the shafting, pulleys, and belts than in actual machine operations. There are certain advantages of individual motor drive which are particularly beneficial in a railway repair shop. No other method permits the development of shop facilities so freely along the lines which could not be foreseen when the shop was first built. There is a constant tendency toward using heavier tools in street railway shops and rearranging them on the floor to facilitate routine operations. The cost of moving tools and changing the shafting and pulleys as the shop grows in size or the character of the work done changes often may be equal to the initial expense for direct connected motors for all the machines. Individual motors can be applied to the larger tools first and to any isolated machine of moderate size for which room cannot be found in the department in which it should be placed. Better light, greater safety to employés and more overhead and aisle space will result from the substitution of individual motors for shaft driving. In many cases the first cost of the motors for individual drive appears so formidable that the economies which would result from a well-planned installation do not receive the consideration to which they are entitled. The first cost can often be reduced by judicious use of second-hand motors. The present tendency in central station operation is to substitute alternating current distribution for 550-volt direct current power supply and this change has released many direct current motors in good condition which could be adopted readily for use in railway shops, which can be bought at low prices."

Growth of Electric Traction.

The new edition of "American Street Railway Investments" gives some striking staitstics with regard to electric traction in the United States. The number of companies now in operation is 1,253, with 40,490 miles of track and 91,153 cars. The capital stock outstanding represents a total of $2,427,935,397, and a funded debt $2,224,800,236, a capital total of $4,652,735,633. Some idea of the wonderful growth of electric traction may be derived from a table relating to 10 companies with gross revenues of $6,000,000 or over. These are the Boston Elevated Railway, Brooklyn Rapid Transit Company, Chicago Railways Company, Detroit United Railway Company, Interborough Rapid Transit Company, Philadelphia Rapid Transit Company, Pittsburg Railways Company, Twin City Rapid Transit Company, United Railways Company of St. Louis, and United Railways & Electric Company, Baltimore. The per cent. of increase in gross revenue for the foregoing 10 companies was 12% in 1906 over 1905, 7·7% in 1907 over 1906, 2·3% in 1908 over 1907, 3·6% in 1909 over 1908 and 27·9% in 1909 over 1905. The total gross earnings were, in 1905, $105,223,534; in 1906, $117,829,774; in 1907, $126,934,285; in 1908, $129,878,049; in 1909, $134,615,487. A group of 20 companies with revenues between $500,000 and $5,000,000, showed gross earnings of, in 1905, $33,674,607; in 1906, $37,465,016; in 1907, $41,215,904; in 1908, $41,405,119; in 1909, $44,051,719. The highest individual earnings in 1909 were the $27,160,036 of the Interborough Rapid Transit Company of New York, and the $26,560,451 of the Public Service Corporation of New Jersey. The next in order are the Brooklyn Rapid Transit Company with $20,300,279, Philadelphia Rapid Transit Company with $18,797,993, the Philadelphia Company of Pittsburg with $18,247,516, and the Boston Elevated with $14,493,853.

Hints for Electrical Engineers.

The manager of a large central station in this city has issued the following hints to new engineers with the corollary that older hands may absorb them also if they are so minded:

When a new machine is installed, or an old one changed over, a sharp look-out should be kept. The bearings of the new machine should be well oiled, and extreme care taken to keep oil out of the armature and off commutators. Run the belt slack, if indirectly connected, at the beginning.

At the start run the machine at light or no load for several hours. It could be a reliable type of generator, or motor, and yet have serious faults in setting up or in foundation.

Never overload a new installation or certain trouble will result. Give it close attention, and remedy at once any running defects. Look out for variation in current and voltages. In a large generating plant trouble often comes suddenly. It is well to be always on the look-out, and act promptly and effectively.

When through with a metal tool, it would be well to put it in its rack in order to avoid danger of field attraction. I always use a copper oil-can in preference to all others.

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Commutators and brushes need unfailing vigilance. I have found that the rest of a well-balanced machine takes care of itself.

Do not monkey with a brush while it is working even if there are others on the same side. Bearings and field coils may be touched once in a while in order to test temperature. Be careful in the matter, though.

I have made it a point, when handling a conductor, to see that no bodily circuit were formed. Do not be afraid of the rubber gloves. Use a handkerchief in keeping the hands in a dry condition.

When the machine is stopped, it should be cleaned and put in condition for next run. Place over it a rubber covering.

I wish to give one more pointer to the new engineer: Do not consider yourself the whole thing in the management of machinery. You're simply a fraction. The other fellows help to make up the unit.

Current Items.

Announcement is made of a remarkable gasolene electric truck performance. On the Indianapolis motor speedway, a 5 ton gasoline-electric commercial truck attained a speed of 26 miles an hour carrying 9,000 lb. of gravel in sacks. The day before a similar truck, acting as a tractor for six wagons, moved a total load of 50 tons. These trucks have a gasoline engine direct-connected to an electric generator from which energy is distributed to motors at the axle of each of the four wheels. The trucks were built by the Universal Motor Company, of Indianapolis.

For use during cold weather, when the trains of the Pennsylvania Railroad entering the New York station through the electrified tunnel zone are disconnected from their steam locomotives and taken across the Jersey meadows and through the tunnels by electric locomotives, steam generated in electric boilers will be used to maintain the temperature in the cars and to keep the train connections from freezing. These boilers will utilise the 600 volt direct current from the third rail, and will have a capacity for generating 1,000 lb. of steam at 80 lb. per sq. in. pressure, each hour.

Wonderful indeed are the uses of electricity. Its latest application has successfully been directed towards the elimination of fleas from a dog. A Chicago electrician has a favourite dog, and from time to time he essayed the old fashioned but only partially effective method of separating his pet from its parasites by immersing the animal in water up to the head and concentrating his attention upon the mobilisation thus effected at the terminal. But one happy day he conceived the idea of bringing an electric vacuum cleaner into operation, using a small nozzle and carefully going over the dog's skin and hair. The dog, it is recorded, did not like the operation very well, but he has been free from fleas ever since. The vacuum removed not only the full-grown insects, but their eggs as well, and the experiment proved a complete success.

The Westinghouse Company has placed on the market an electrically-driven rotating eraser for the use of draftsmen to remedy mistakes and alterations in inking tracings. The eraser is attached to a flexible shaft equipped with a one-twentieth horse power motor running at 1,700 r.p.m. and taking power from any convenient lamp socket.

Niagara Pipe Line.

The concrete pipe line just completed for the Ontario Power Company is declared to be unique in its engineering features among the great pipe lines of the continent. It is, in fact, the only one of its kind and size in the world. In diameter it is 18 ft., and a mile and a quarter in length. Costing over a half million dollars, it took but five months to complete it. Resting on a solid foundation of concrete, it traverses a section of almost every known variety of soil. Rock, gravel, loam and quicksand were encountered, and the work was at times desperate at a depth in places of 35 ft. to shallower depressions of but 15 ft. The number of bags of cement used ran up to 247,642 besides 2,350 tons of steel. Its walls are fully 18 in. in thickness. The big pipe could easily be used as an underground railway tube for an ordinary trolley or passenger train.

Ice-making as an Off-peak Load.

Writing in the Chicago "Electrical Review" on the art of making a uniform 24-hour load, Mr. Joseph Baker deals with the possibilities offered by ice-making. It seems that a recent process in which a complete make of ice may be produced in less than 20 hours places the ice business in an entirely new light to the central-station manager, inasmuch as a station may be equipped with an ice-making plant without any disturbance or addition to the peak load, since the ice apparatus may be completely shut down and the ice harvested during the heavy-load period. In supplying power to an artificial ice-making plant the station can safely figure on a load of about 2 kw. for every ton of capacity of the ice plant, so that a 50-ton plant would consume 100 kw. for 20 hours, or 2,000 kw. hours every night. The added cost to the station would be about 3½ tons of coal per day, the oil, wages and repairs remaining the same, so that the manager can easily afford to make a concession from the usual rate since the cost per kilowatt-hour will be considerably less than 1 cent. On the other hand, the returns to the customer from the ice sales should bring a suitable profit, since 50 tons of ice can be turned out every day at a cost for power of only 40 kw.-hours per ton. With ice valued at $3.00 per ton. at the plant and a low rate of manufacturing labour per ton the ice maker could afford to pay from 3 to 5 cents per kw.-hour, which would be an ample return for the station manager. A still better proposition would, of course, be the installation and operation of the ice plant by the central station itself. With a short transmission, attendance always at hand, and an absolute control of the load so connected, the ice plant can be run at only such times as are advantageous to the station and with very little cost. The engineer can readily adapt himself to the care of the brine pumps during the 20 hours of ice freezing, and extra men can be called in for 3 or 4 hours during the peak load to harvest the ice. The plant can be operated at any time during the year which is convenient for the station, since the ice can be stored with good results for six months without refrigeration. It is fortunate, however, that the heavy ice consumption of summer comes at the light part of the station's yearly load so that less storing is required than would at first sight seem necessary. The essential point of interest in the new ice process is the rapid production which is made possible by the method of freezing from the centre. The apparatus consists of a series of pipes which are lowered into tanks of water. The brine is pumped through the chain of piping until the ice is formed into solid cakes which cling to the pipes. The piping or grid, together with the ice, is then raised by means of a hand crane and warm brine is passed through the grid for a few minutes to release the pipes from the ice. A power saw hanging from the crane then cuts the large cakes into market size, and the ice is ready for delivery. Ice from this process is clean in every respect and perfectly pure.

Progress of the Electric Furnace.

Discussing the rapid strides made by the electric furnace towards a place of commercial practicability in the manufacture of iron and steel, the "Railway and Engineering Review" cites cogent reasons why the electrical production of iron and steel may be expected to become one of the most important factors in the industry. "The modern development of the steel industry," it is pointed out, "tends largely to the use of special steels. It is being demonstrated that a number of the rarer metals have valuable qualities as a constituent of steel, and it is likely that in the near future a large proportion of the steel produced will be of special composition. These steels, to be of utility, must be made to exact chemical and physical specifications, varying in each case and for each special purpose, among which may be mentioned high-speed tool steel, steel for automobiles and perhaps aeroplanes, steel for special castings, for boiler plates, for railway trucks, for special track work, for bridge materials and for rails. To the exacting requirements of making these special steels, the electric furnace seems to be peculiarly adapted, and, in fact, it has actually been used in producing most of the special steels brought out up to this time. A particularly valuable feature of the electric furnace in this respect is the possibility of maintaining exactly the same composition in repeat orders for the same material, a thing that at present is exceedingly difficult to obtain. It is

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commonly considered that the cost of current will be the great obstacle to the general introduction of the electric process. It seems, however, that this item has been exaggerated, or at least that the newer types of furnaces have cut down the current consumption to a reasonable figure. It is claimed that the use of the electric furnace is not prohibited even where the cost of the current is as high as 2 cents per kilowatt hour. And there are many places where current should be obtained much cheaper than this, especially in view of the fact that the electric furnace gives a very advantageous load factor, and also that the running may be regulated to avoid the hours when the commercial electrical plants are burdened with their peak loads. These two advantages also apply to induce a favourable rate for current where hydro-electric power is available."

Economy as a Factor.

The "Railway and Engineering Review" goes on to point out that in plants where the waste gases from blast furnaces or coke ovens are available, it might be much more economical to use the electric current generated from these sources in operating electric furnaces, even at the cost of supplying the other power needs of the plant from an independent source. As for definite figures regarding power consumption, it is stated that the 1-ton Stassano furnace will require 200 kilowatts of electricity for a period of 4 hours, making about 800 kilowatts per ton of steel produced. There are, of course, other important items in operation, such as maintenance of the furnace and linings, consumption of electrodes, etc., which at one time were quite formidable, although it is stated that they have been largely minimised in the later types of furnaces. In the manufacture of steel castings a decided economy comes into the calculation, in the cheaper cost of the initial materials. For the highest grade steel, such as frequently is required in railway work or for other special purposes where lightness and strength is required, an instance is quoted where pure Lancashire and Swedish iron formerly was used in the crucible furnace at a cost of $48.60 per ton, the castings costing from $73 to $97 per ton. With the electric furnace the cost of production of these same castings amounted to only $43.75 per ton, including all capital charges, the initial material being scrap at $16 per ton. The current cost was 1 cent per kilowatt hour, and the total cost of current, maintenance of furnace, electrodes, etc., was $15.40, being considerably less than the cost of crucibles, coke, wages, etc., in the previous instance. These furnaces work well in small capacities, and this fact, together with the factors just mentioned, points to the possibilities of their use, not only in iron and steel works, but in locomotive and car shops, bridge works, machine shops, and other manufacturing plants and industrial plants. The raw materials in these places would be scrap, trimmings, punchings, steel and iron borings, etc., making it possible to deliver the output at very low price, and also to regulate the deliveries to suit the needs from day to day.

Leakage Impedance of Transformers.

Some striking conclusions with regard to the leakage impedance of transformers are recorded in an article which has been written by Mr. K. Faye-Hansen for the current issue of the New York "Electrical World," from which it would appear that electricians are in error in regarding the leakage impedance as constant. Summarising Mr. Faye-Hansen's tests editorially, the "World" says that in a constant-potential transformer the magnetic leakage impedance consists of the combined equivalent series resistance of the primary and secondary windings and the local reactance produced by the flux formed between the two windings by the magnetomotive forces of the primary and secondary currents. The path of the latter flux is largely in air, although a certain short length is within the main magnetic core. Evidently in any chosen transformer the leakage flux varies directly with the magnetomotive forces tending to produce it and inversely with the reluctance encountered in its path; the leakage reactance, therefore, varies directly with the permeance of the total path of the leakage flux. When an overwhelmingly large part of the reluctance is subject to no change whatever and the remainder changes only slightly, as is true in the constant-potential transformers as usually constructed and operated, the leakage reactance and the leakage impedance may well be considered constant. The part of the reluctance subject to change is that within the magnetic core of the transformer, which carries the main flux upon which the leakage flux is superposed. Only when the total core flux reaches a high density does the reluctance change appreciably and even when the density approaches the saturation point the part of the total reluctance which does change is so small in comparison with the total that the final effect upon the leakage reactance is unimportant. Seldom indeed was the saturation density reached in the earlier types of high-frequency transformers, but the introduction of silicon steel with low specific loss has resulted in a general increase in the density from a low-reluctance value at, say, 6,000 lines per square centimeter to a high-reluctance value at probably 10,000 lines per square centimeter. The significance of this relation is that while the core portion of the path of the leakage flux in the earlier transformers was of low reluctivity, in the later designs it is of high reluctivity; however, in standard designs of transformers the reluctance in the core is a minor part of the whole reluctance of the leakage path. In the tests reported by Mr. Faye-Hansen, not only were the transformers overated at extremely high densities, reaching values as great as 15,000 lines per square centimeter, but that portion of the leakage path ordinarily in air was formed by interposed iron laminations. The value of the leakage flux was greatly augmented by the presence of these laminations, but to what extent any variation in the value of the leakage impedance with the main flux density was due to the use of the extra laminations the "World" is unable to judge from the recorded data. But the tests are of value in showing results to be expected under extreme cases and in pointing to the desirability, in designing modern silicon-steel transformers, of considering certain features that could well have been neglected in the earlier plain-steel transformers.

ELECTRIC POWER IN CANADA.

Among the many big schemes for the generation and supply of electric power in Canada, one of the most interesting is being carried out in British Columbia by the Western Canada Power Company, Ltd., on the Stave river about 35 miles east of New Westminster. This plant is being installed at a cost of $2,500,000 and when completed will be capable of supplying 50,000 h.p. The whole country for a radius of 175 miles around the plant may be supplied with light and power, and electric lines built throughout that section of the province.

At present a gang of about 235 men are employed on the erection of a dam across the river and the building of a power plant, while 100 more are working on the construction of a railway line from the Canadian Pacific Railway main line at Ruskin to the site of the plant. During the next few months this force will be augmented by contractors engaged in erecting transmission lines throughout the lower Fraser valley, sub-power stations, and other necessary features of the establishment of a plant of this nature.

At the outset the intake dam across the Stave river for this power plant will be 35 ft. in height and only two units of 13,000 h.p. each will be installed. This will be doubled as the demand for power increases, the height of the dam being increased to 60 ft. to give the necessary head of water. Further down the river, about 3 miles from its mouth, at the canyon the whole plant may be duplicated and another 50,000 h.p. manufactured. The company has secured the water rights at this point to provide for this contingency.

Mr. R. F. Hayward, general manager of the Western Canada Power Company, and chief engineer, expects to have the first unit of the plant installed and ready to supply power about April 1, 1911, and the second unit by July 1. Transmission power lines will be put up at once. The company also propose to construct and operate electric car lines through the province, although their plans in this connection are not yet matured.

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Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

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Second-hand Plant and Machinery Advertisements 24 words 1s per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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A QUESTION OF PROFITS.

A question often raised is that of profits as understood when applying respectively to a trading company and to a municipal undertaking. It is a question of the utmost importance to the future expansion of the electrical industry, because every trading concern must be carried on under sound commercial principles if serious difficulties are to be avoided. The present fashion among a certain school of economists and financiers is to apply rules of far greater stringency to municipally-owned concerns than to those exploited for the benefit of individual proprietors. A difference between the two certainly does exist, but it is all in the favour of the ratepayer-owned undertakings, as it is not only fair, but the only sound way, to treat these as part of a whole, resting upon the credit of the entire community, and carried on for their benefit. Thus it is quite within the bounds of strict economics that it may be proper to carry on an undertaking at a loss, if its work is absolutely necessary, or largely beneficial to the community. This is so because it is merely a branch of local governance. Take the problem of sewage disposal. We have had many economic and sanitary experts holding that sewage disposal should be carried on as a profitable undertaking. In practice, however, all theories of this kind have broken down, whether managed by public or private bodies. We, therefore, carry on sewage disposal at a very heavy expense to the community, yet we cannot call this a loss, because as a result of the costly sewage systems there is a saving of life, a reduction of invalidity, and a saving on hospital and other outlays. So we carry on sewage disposal regardless of direct profit, and rightly so as regards the community, though it would be an act of criminal folly for the directors of a company to do this, unless, indeed, they were carrying out a sewerage scheme on some outlying works, knowing that this costly sanitation would keep their men in better health, and so indirectly benefit the whole trading venture. This line of argument can legitimately be applied to electrical undertakings, for although the supply of electricity is not in the same

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degree a necessity as the removal of sewage, yet good light and cheap power are necessaries to the modern community. Within bounds, it may be wise, and perfectly good finance, to supply electric light and power even at the cost of relying upon the general rates fund, if thereby the hygienic conditions and commercial prosperity of the ratepayers as a whole are benefited. In the vast majority of cases, however, there is no need to fall back on this plea, because a tangible profit is actually made. The question is, how is that profit to be calculated? In this matter the sentiment of the school of economists and financiers above referred to, and to a certain extent the laws of the land, are rather hard upon community-owned undertakings. This is well brought out by Mr. C. J. Spencer, general manager of the Bradford City Tramways, in his recent annual report to his committee. Bradford, for the year 1909–10, made a gross profit of £88,997 by running its own trams. This gross profit was disposed of as follows: Interest on capital £22,407, income tax £2,250, rent on leased lines £4,137, repayment of mortgage loans £1,112, sinking fund £29,342, transferred to reserve and renewals account £12,363, paid over in relief of city rate £20,000. Now, critics would argue that the city of Bradford Tramways groans under a debt of £930,113, even if we call it capital, it will be argued that £20,000 is a poor return. But Mr. Spencer justly claims that the interest should also be taken into account, and then we find that the profit is £42,407; moreover, the city tramway loans are being wiped out by a heavy contribution of some £30,000 a year to the sinking fund, while, simultaneously, the amount placed to reserve for renewals (£12,363) is at a far higher rate than prevails in company-owned tramways. For the purposes of comparison, Mr. Spencer takes a tramway in the South of England. The city had a revenue of £262,311, the company £263,689; the expenditure was, respectively, £170,699 and £178,342. It will be seen that they are fairly comparable. Now let us look at the results. The city made a gross profit of £91,613 (including bank interest on balances, etc.), the company £85,347. The city paid £72,861 in interest, sinking fund and contributions to rates, the company £76,639 in interest; but the city placed £12,365 to credit of renewals account, the company only £8,708. While the position is slightly in favour of the municipality, the average critic would compare the two results to the detriment of Bradford. This biased and erroneous way of argument undoubtedly hampers electrical development, and therefore is to be deprecated.

BOOK REVIEWS.

"Electric Motors: Their Theory and Construction." By H. M. Hobart, M.C.Inst.E., M.I.E.E. London: Whittaker & Company. Price 18s. net.

This is the second edition of a well-known book which has stood in the front rank for the past six years. It, however, is practically a new work, for much of the first edition has been discarded, long passsages have been re-written and the information brought up to date, recording all the improvements that have been introduced from time to time. For instance, there is an extensive new section devoted to single-phase motors. It is an exhaustive statement of the present state of the subject, and is splendidly illustrated.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "The Editor, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

LIGHTING OF LONDON.

Sir,—I send you for the information of your readers, copy of a letter which has been sent to all the principal papers throughout the country in the interest of supply undertakers generally, and in response to numerous enquiries received by the Committee.

[copy.]

LIGHTING OF LONDON.

A most misleading impression has recently been created by certain paragraphs appearing in the Press under the above heading. The impression given was that London, instead of continuing an electrically lighted city, as at present, was about to revert to gas.

I need hardly say that nothing is further from the truth. The case, however, presents an interesting example of how easily an erroneous impression can be set afloat. The facts are as follows:—

One of the 29 London authorities, influenced by conditions which were purely local, decided to alter a few of their numerous electric lamps to gas lighting. The number of the lamps involved is quite small compared with the total number of lamps in the borough in question, and is altogether negligible in comparison with the total electric lighting of London. The whole case, in fact, is simply a local matter, confined to one authority only, and is quite undeserving of the wide publicity, were it not for these incorrect rumours which have given rise to so much misunderstanding.

For corroboration of the facts, reference need only be made to the official statistics of the London County Council, where it will be seen that the use of electric street lighting has more than doubled in half a dozen years, and that only 10 out of the 29 London authorities are wholly without electric street lighting.

As to the relative cost of electricity *versus* gas for street lighting, I need only mention that in St. Marylebone the saving effected last year was £1,500 in respect of a portion of their area only, and that this has encouraged them to convert the whole of the remaining gas lamps to electric light, which will bring the saving up to £2,600 per annum.

Further, the boroughs of Hampstead and Shoreditch—already extensively electrically lighted—are extending electric lamps practically throughout the whole of their areas.

Thanking you for your courtesy in giving publicity to these facts.

I am, yours truly,

H. B. Renwick

(Chairman of the Electric Supply Publicity Committee).

The Electric Supply Publicity Committee,
Moorgate-court, Moorgate-place, London, E.C.
September 13, 1910.

PERSONAL.

Mr. J. M. W. Munro, who recently retired from the firm of Anderson and Munro, electrical contractors, Edinburgh and Glasgow, is now devoting himself to electrical engineering consulting work.

Mr. J. W. Fraser was made the recipient of a handsome writing case, subscribed for by the employees of the London County Council Tramways Power House, Greenwich, upon his leaving the department in order to take up a Government appointment.

Mr. Joseph Mooney, J.P., has been co-opted as a director of the Dublin United Tramways Company, to fill the vacancy created by the death of Mr. William Anderson.

We regret to record the death of Mr. William Finlay, electrical contractor, of Frederick-street, Edinburgh, past-president of the Electrical Contractors' Association (Incorporated), at the early age of 38.

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PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

"SALFORD" IRONCLAD SWITCHGEAR.

During the past year the General Electric Company, Ltd., have developed, and are now placing upon the market, a line of ironclad switchgear, as shown by the accompanying illustrations, all of which are made throughout in their Witton Works, near Birmingham, part of which have been specially equipped for this class of work.

The present design is the result of very careful investigation into the requirements of home and foreign markets, and no expense or trouble has been spared to reach the desired standard.

The gear consists of 2 and 3-pole switches, 2 and 3-pole switches combined with fuses in the same box, ammeter and voltmeter cast iron cases, which can be attached direct to the switch cases, conduit boxes which are used when all the conductors are brought in through a single conduit, and fuse boxes.

FIG. 1.

The switches, switch-fuses, and fuses only are made in the following capacities:—15, 30, 60, 100, 200 amp. The switches and switch fuses are made 2 and 3-pole, while the fuses are made single pole only. All the gear is suitable for 500-volt circuits, and the cases are watertight and fool-proof (*i.e.*, the switch and switch-fuse cases are arranged so that the cover cannot be opened as long as the switch is "on," and the switch cannot be closed as long as the cover is open).

It will be seen from the illustrations that the articles have a workmanlike and substantial appearance. The castings are smooth and neat in finish, the material being first-class soft iron. This latter point is important as with the usual cheap brittle iron breakages are unavoidable if the weight of the article is kept within reasonable limits.

Fig. 1 shows a 2-pole 100 amp. switch in the "on" position.

Figs. 2 and 3 show the same capacity switch but combined with fuses; Fig. 2, in the "on" position, and Fig. 3 in the "off" position with the cover open. In this latter illustration the whole interior arrangement can be plainly seen. The switch is located in the upper part of the box, where the leads from the line are brought in, so that if the switch is open only the top or break contacts of the switch are alive. Between the switch-blades are barriers of special fireproof insulating material, while the sides and the cover of the box are also protected with an arc-proof lining. The fuses of the porcelain expulsion type are all boxed in with strong fire-resisting insulating partitions and a heavy plate of insulating material is fixed to the cover over the fuses so that if the box is closed each fuse will be contained in a separate compartment of insulating material.

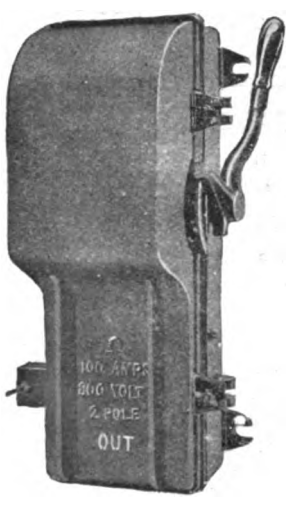

FIG. 2.

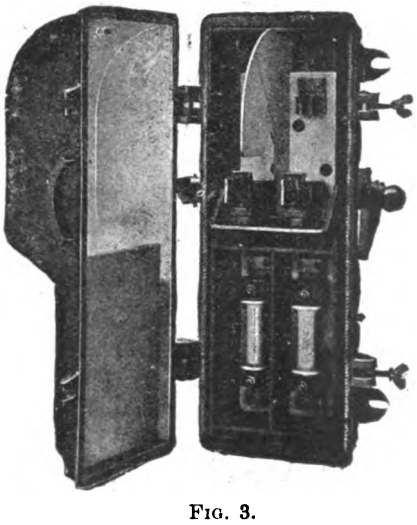

FIG. 3.

The upper contacts of the switch which are the only parts alive when the switch is "off" can be covered over altogether by a plate of Uralite or similar material, which would have narrow slots to allow the switch blades to pass through. This arrangement makes it quite impossible to touch live metal when the switch case is open.

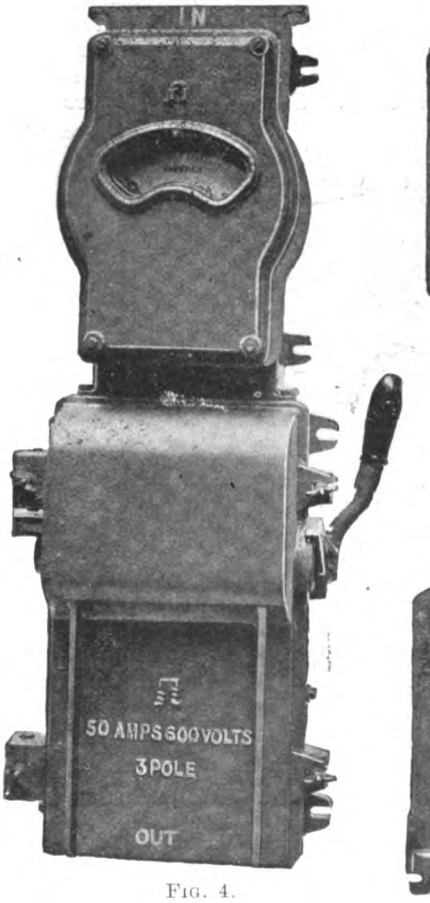

FIG. 4.

FIG. .

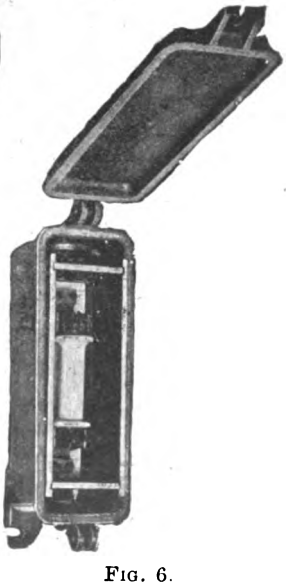

FIG. 6.

Fig. 4 shows a 50-amp. switch fuse with an ammeter attachment, and Fig. 5 is of a conduit box. These ammeter attachments and conduit boxes are only made for the

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50, 100 and 200 amp. sizes, there being scarcely any demand for ammeters for very small motors, and there is no need for a conduit box in the 15 and 30 amp. sizes, as these two sizes are made only with a single inlet hole at each end tapped to take conduit.

Fig. 6 shows the fuse box, which is used where separate switches and fuses are preferred.

As mentioned above, these fuses are made single pole only, they are protected by heavy partitions of insulating material in exactly a similar way as the fuses in Fig. 3. It is therefore quite impossible for the arc to reach the cast-iron case, even should the porcelain holder burst.

Special attention is drawn to the fuses which, although slightly more expensive than some of the inferior articles now on the market, are certainly a most highly efficient protective device and well worth the additional initial outlay.

MINING PANELS.

It has been our pleasing duty to report from time to time steps taken by manufacturers to add to the safety of electrical appliances. As shown only last week in these columns, the percentage of accidents is steadily decreasing each year. The necessity for precautions is particularly needed in the matter of apparatus intended for use in connection with mining both above and underground, owing to the special risks connected with the work. This has always been recognised by Messrs. A. Reyrolle & Company, Ltd., of Hebburn-on-Tyne, who are so largely responsible for mine electrification at home and abroad. It is a point of view again made manifest in their latest type of panels, which we illustrate. In both instances the cover of one of the isolating switch chambers has been removed merely for the purpose of giving a view of the interior. These panels are so designed that the isolating switch cannot be opened until the corresponding oil switch has been put to the "off" position, while the oil switch cannot be put "on" again so long as the isolating switch remains in the "off" position. Each door is interlocked and cannot be opened until all pressure has been cut off the panel by the isolating switch. It will be seen, therefore, that everything has been thought of, and security made doubly sure. Our illustrations represent standard types of panels, but these can be modified to suit particular cases. For instance, where flame

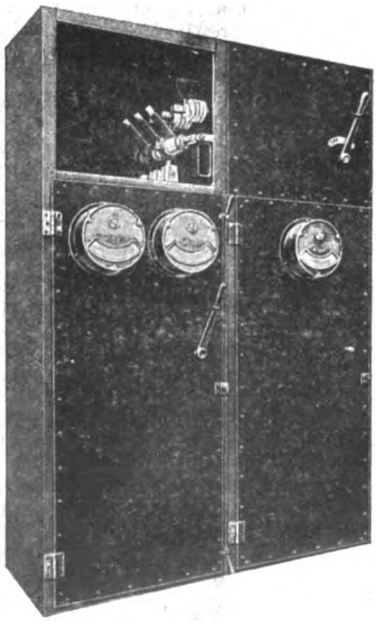

FIG. 1.—PANEL, WITH TOP COVER REMOVED FOR PURPOSES OF ILLUSTRATION.

and explosion-proof gear is needed Messrs. Reyrolle recommend the enclosure of the various parts in a stronger make of cast-iron boxes, provided with wide machined joints, for this, as is pointed out by Professor Thornton in his pamphlet on Electricity in Coal Mines, discussed in our leader columns a few weeks back, is found to be an effective protection against emission of flame. Other modifications are introduced as occasion and local conditions demand. Thus, the panels can be designed

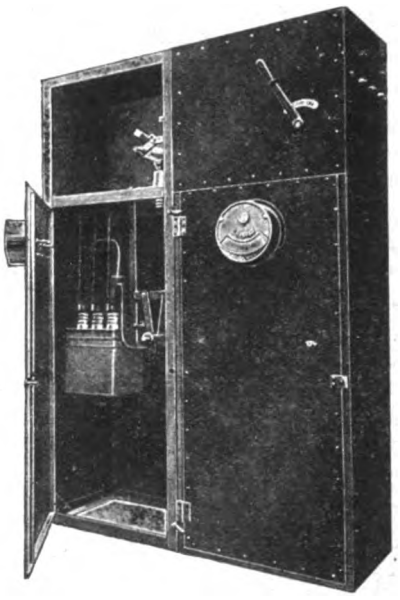

FIG. 2.—PANEL, WITH ISOLATING OIL SWITCH DOOR OPEN.

to accommodate current and potential transformers, and the fronts can be fitted with any combination of instruments required. It is a departure which should commend itself widely among electrical mining engineers.

CATALOGUES AND PRICE LISTS.

The following catalogues and price lists have been received:—

Messrs. Crossley Brothers, Ltd.: New illustrated catalogue and price list in album form, giving full details of various types of gas engines. A useful, well arranged production.

Western Electric Company, Ltd.: Bulletin 4003 is a neat pamphlet on "Western Electric Inter-Phones," dealing with private line telephones and installation accessories.

Morris & Lister, Ltd.: Illustrated price list and description of "M. & S." Auto-Transformers.

Adnil, Ltd.: List 123 E., an illustrated catalogue, giving full particulars of motors ranging from 3 to 68 h.p., and dynamos from 2·5 to 48 kw.

Engineering Supplies, Ltd.: Illustrated leaflet descriptive of steel mercury and various types of compensation thermometers, pyrometers, thermo governors, and distant draft gauges.

J. H. Holmes & Company: Catalogue of D.C. "Castle" two-pole motors and dynamos.

Bowesfield Steel Company, Ltd.: Illustrated price list of black and galvanised, plain and corrugated steel sheets, bolts, nuts and other fittings.

Loxley & Company, Ltd.: "V.B." cleat ceiling roses for surface wiring.

Meirowsky & Company: Abridged price list of insulation materials.

Siemens Brothers & Company, Ltd.: (1) Dry cells, dry cell batteries and accessories illustrated price list; (2) Optical pyrometers, stand and portable types, illustrated price list.

The Newall Engineering Company (Peter Hooker, Ltd.): Well illustrated descriptive catalogue of Newall gauges, micrometers and measuring machines.

The Bureau of American Manufacturers in Europe, Ltd.: Catalogue of American novelties, machinery, specialities and staple articles.

Simplex Conduits, Ltd.: Sheet F. 1. Ship electric light fittings. Very good designs.

The Union Electric Company, Ltd., have brought out an illustrated price list, giving very full particulars of their direct-current motors. These include sizes from ¼ to 50 h.p., all of which embody the best design. A large variety of types are shown, including totally enclosed and rainproof patterns, and suitable for domestic and workshop purposes.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ABERDEEN.—Mr. Bell's recommendation that the price of current for heating purposes should be reduced to 1d. per unit has been adopted.

BELFAST.—The street lighting question is becoming acute, complaints being rife that only Donegall-place and Castle-junction are properly lighted. Shortly the Police Committee will replace gas by electricity in Castle-place and High-street as far as the Memorial as a trial. If this proves successful, electricity will replace gas in all streets, though the change may be brought about gradually.

BRADFORD.—The City Tramways for the past financial year had a revenue of £262,311, and a gross profit of £88,997 on the working; a sum of £20,000 was paid in relief of rates, and £12,365 placed to renewals account. The parcels department brought in £8,169, an increase of £819, and the motor garage department £1,637, an increase of £153. The power expenses were reduced from 2·115d. to 2·073d. per car mile.

CANTERBURY.—It has been decided to replace gas lighting by electricity at the Workhouse and Infirmary. The Corporation Electrical Engineer estimates the cost of installation at £165. A substantial saving in annual charges is expected.

CLECKHEATON.—An application to the Local Government Board has been made for powers to borrow £2,210 for electricity extension work.

CLEVELAND.—A local correspondent reports rapid progress in the distribution of electrical power on the river Tees and Cleveland ironstone district, the authorised area of supply of the Cleveland & Durham Electric Power, Ltd. At the Skelton Park ironstone mine of Messrs. Bell Brothers, Ltd., two new 400 h.p. transformers have recently been put to work to supply current for several surface motors and a fan. Several other underground electric motors will shortly be put into commission. An extension has lately been carried out at Sir Bernard Samuelson & Company's ironstone mine, two transformers, each 125 h.p., having been installed for transforming the current from 11,000 volts to 440 volts. These transformers have been constructed by the A.E.G. Company of Berlin, and the total capacity of the sub-station is now 1,600 h.p., the power being supplied from the 11,000 volt network of the Cleveland & Durham Electric Power, Ltd.

COLWYN BAY.—The District Council propose to extend their electricity supply to Old Colwyn. This will involve laying a cable of close upon 1½ miles at a cost of £2,300. Promise of support has already been received, notably from the Sanatorium now being built. An application for powers to raise a loan was made to the Local Government Board. At the inquiry the Inspector said that henceforth expenditure on services and meters would have to be met out of revenue. Before permission to increase loans was given, the amount spent on a steam engine which had been scrapped would have to be wiped out. He, however, advised the Council to increase the application by £1,000, to cover further extensions of the mains.

COOKSTOWN, IRELAND.—A motion before the Urban Council that an electric lighting scheme be adopted having been lost, it was decided to approach Messrs. Adair if they would consider the question of supplying electricity from their power station for the lighting of the town.

DOLGARROG.—The Board of Trade have recently confirmed the undermentioned Order made by the Light Railway Commissioners:—Dolgarrog Light Railway Order, 1910, authorising the construction of a light railway in the parishes of Maenan, of The Abbey, of Llanrhychwyn, of Caerhûn, of Dolgarrog, and of Trefriw in the county of Carnarvon.

DYSART.—The Town Council have agreed to open negotiations with Fife Electric Power Company for the supply of light for the burgh.

EASTBOURNE.—Great praise is bestowed on the method of distributing the electric light at the Floral Hall, which is, as far as possible, by the indirect principle, the lamps being mostly hidden.

GRANTOWN.—The Council is in a difficulty about street lighting. Apparently nobody wants gas. The British and Colonial Lighting Company are to be permitted to put up a petrol and air gas lamp on trial. The town might be worth considering by electric lighting contractors, as shopkeepers and private persons are also anxious for a good light.

GREENOCK.—The news is confirmed that the Admiralty have informed Greenock Corporation that the supply of electricity required by them for the torpedo factory at Battery Park will be 400 kw. This is exactly double the original contract.

LEEK.—The Sanitary Department is investigating the gas producer plant system at the Corporation electricity works.

LISTOWEL.—A requisition by the majority of the ratepayers has been sent in asking for improvement in street lighting, and expressing a preference for electricity. The Council decided in favour of electricity and application has been made to experts for suggestions.

LLANGOLLEN.—A dispute has arisen between the Town Council and the Llangollen Electric Light Company, Ltd., over questions of accounts. The Council have apparently been charged for certain mains, those the Company are bound to lay there; they, however, dispute liability for those actually laid by the Council without previous sanction. There is also a dispute as to the amount to be refunded to the Council for clearing lands, a duty which should fall on the Company. A special meeting is to be held to consider the various questions.

LONDON: SHOREDITCH.—The Borough Electrical Department shows an increase of revenue for the year ending March 31, of £1,598 11s. 7d.; while on the expenditure side there is a reduction of £1,031 9s. 3d.; the gross profit before meeting loan charges, bank interest, etc., being £23,876 4s. 8d., as against £21,335 4s. 8d. for 1908–9. The surplus on the year's working, £6,431 19s., is disposed of in wiping off the debit balance brought forward, and by a transfer of £1,486 14s. 3d., to change of pressure account and £4,000 to the reserve fund, leaving a credit balance of £616 16s. 7d. to be carried forward. The total costs per unit sold show a reduction of 28d. compared with 1908–9.

MELROSE.—It is rumoured locally that the Electric Supply Corporation intend extending their main across the Tweed to Gattonside, and that the work will be commenced shortly. Also as an experment, two metallic filament lamps of 100 c.p. each are to be erected in the streets, one at the top of St. Dunstan's-lane, and the other in Buccleuch-street.

NEWCASTLE, IRELAND.—At the last meeting of the Council, Mr. M'Cartan, the Council's solicitor, forwarded draft agreement with Messrs. Fraser, Lewisham, with regard to the installation of electricity in the town, which was approved, and directions given to forward for approval by the proposed undertakers.

PORTRUSH.—The Council have arranged to have an interview with Mr. H. V. Pegg, of Messrs. Miller, Wilson, & Pegg, electrical engineers, in reference to the capital outlay and annual working costs involved in a scheme of electric lighting.

SEVENOAKS.—The project of lighting Sevenoaks by electricity has advanced another step. A committee has been appointed to ascertain the cost of an eligible site for an electricity generating station.

STIRLING.—The Scottish Central Electric Power Company having applied to the Central District Committee of Stirling County Council for permission to cross certain of the highways with overhead high-tension wires conveying current from Denny to their customers in Stirling district, the request was granted.

SWANSEA.—The Corporation Electric Lighting and Tramways Department have had their assessment increased by £753, which will go far to wipe out the profit of a little over £1,000 made last year.

TORQUAY.—The Local Government Board have written to the Town Council that their Inspector reported that at the application for sanction to borrow further moneys for the electricity undertaking was amended at the inquiry, and that the Council now desired to borrow £4,500 for defraying the cost of mains laid during the three years ending December 31, 1912. The Board were prepared to sanction a loan of this amount, but before doing so required to be furnished with a copy of a supplemental resolution authorising the increase of the amount of the application to £4,500. It was decided at the inquiry to charge to revenue account the excess expenditure of £486 incurred up to December 31 last in connection with the undertaking, and that all expenditure after that date in respect of sub-stations, transformers, services, and meters would also be defrayed out of this account. The practice of the Council to pool into one common fund all the loans raised for the purposes of the undertaking was irregular. In future the expenditure under each sanction granted by the Board should be kept strictly separate, and the moneys borrowed under each sanction should be applied only to the specific purpose for which the loan was authorised. In reference to this letter, it was decided to ask the Local Government Board to increase the amount of the loan to £4,500. The other portion of the letter was referred to the Electric Lighting Committee.

WEST BROMWICH.—A Local Government Board inquiry has been held into an application for powers to borrow £11,386 for the purpose of the electricity undertaking. The Inspector, Mr. H. R. Hooper, M.Inst.C.E., strongly deprecated the spending of nearly £12,000 on the extension of the D.C. system, when a change to A.C. would give current for power purposes at a much cheaper rate. West Bromwich had done very well so far, but they could do better from the cheap power point of view in adopting the A.C. system. The Electrical Engineer declared that the whole matter had been carefully considered, and it was considered advisable to stick to the D.C. system for the present.

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OVERSEAS.

ARGENTINE.—The following notes from the different provinces are to hand: The Zárate Electric Light Company has been sold to an English syndicate.—The Paraná Municipality is calling for tenders for an electric tramway.—The Municipality of Maipu are calling for tenders for public electric lighting.—The Municipality of Colon, Province of Buenos Aires, are calling for tenders for an electric light station.—The concession granted to Sir R. Reinholg, for an electric light station at Venado Tuerto has been vetoed.

BUENOS AIRES.—The Minister of Public Works has issued a decree granting to Messrs. Paquet y Cia a concession for the construction and working of an overhead electric carrier across the Riachuelo river. The concessionaires have a six months' option to construct another overhead carrier, and also permission to import any material free of duty. Two years are allowed for the completion of the work.

HONDURAS.—The Government have granted a 20 years' concession to a company for the erection of an electric-light plant at Baracoa of Puerto Cortez, to be known as "The Puerto Cortez and Baracoa Electric Company." The company will furnish electric light to the neighbouring towns and power to tramways, railways and industrial enterprises. Permission is given for the construction of telegraph and telephone lines. Another electric light concession has been granted also for a period of 20 years for the installation of an electric light plant in the city of San Pedro Sula. This company will operate under the name of "Empresa de Luz Electrica de San Pedro Sula," and will supply light and power for the same purpose as the electric company first mentioned.

SHANGHAI.—The Electricity Department are anxious to receive tenders for the supply of electric heating and cooking appliances.

UTRECHT, NATAL.—An electric generating plant is being installed in the Utrecht colliery (Natal) for the purpose of working the colliery by electricity. It is proposed to light the town of Utrecht from the power plant of the colliery, and eventually to establish a general system of power distribution in the district for agricultural and industrial purposes.

TRACTION.

HOME.

BOURNEMOUTH.—The Town Council had before them a recommendation from the Tramways Committee that Messrs. W. Griffiths & Company's tender of £2,904 for supplying rails for tramways should be accepted. Alderman Youngman moved that a Leeds tender at £3,299 should be substituted, as there was only a difference of £397 between that and the tender for Belgian rails. The Committee's recommendation meant that British labour would be deprived of £1,500. Councillor Saunders inquired whether rails manufactured in Leeds were as good as those made in Belgium. The general manager of the tramways replied that Belgian rails were superior. On a division five voted for the amendment and nineteen against it.

KEIGHLEY.—A movement in favour of the adoption of the trackless trolley system by the Corporation is being promoted. It is argued that as both Bradford and Leeds secured Parliamentary powers in this direction, it ought to be easy for Keighley, as the system could at once be introduced on routes where there already exists a paying traffic.

KIRKCALDY.—The extension of the tramway system to Dysart is being carried on rapidly by Mr. Dobson, of Edinburgh, the permanent-way contractor. It is expected to be open for traffic by the end of the year.

READING.—On Sunday, September 11, the fourth annual Church Parade in connection with the Reading Corporation Tramways Department took place. The General Manager, Mr. W. Binns, and officials of the department were present, and about 100 men took part in the parade. The Reading Temperance Band led the men to St. Giles' Church, where they attended divine service at 10 a.m. The band played the music during the service, and a stirring address was given by the Rev. T. Guy Rogers, B.A. A collection was made on behalf of the Royal Berkshire Hospital, and after the service the men marched back to the depôt, where they were formed up in square, and were addressed by the Chairman of the Tramways Committee, Mr. Alderman C. G. Field, J.P., who complimented the men upon their smart appearance and congratulated them upon the success of the parade. After the men were dismissed the band played for about an hour in the Depôt Square, which was filled by the public, who greatly appreciated the music discoursed by the band.

WEYMOUTH.—In view of the proposal that the Town Council should adopt a tramway scheme, a local newspaper "The Telegram," instituted a poll of the burgesses, and succeeded in getting about 75% to record their votes. Of these, 1662 voted against the project and 1,320 for. Sixty-two of the "ayes" and 68 of the "noes" were in favour of a tramway system if run by a private company.

OVERSEAS.

ADELAIDE.—The Premier of South Australia, Mr. Verran, has undertaken to bring down the Tramways Amendment Bill early enough to permit members of the House of Assembly making amendments in it which would prevent the mutilation of the Adelaide city squares.

AOSTA.—A company entitled the "Società Anonima Tranvia Elettrica Valle di Gressoney" is about to be formed, with a capital of 1,500,000 lire (£60,000) for the purpose of constructing and working an electric tramway between Pont S. Martin and Gressoney la Trinité. The cost of construction is estimated at 1,140,000 lire (£45,600).

HOBART, TASMANIA.—The municipal authorities of Huon, Lovett, Esperance and Kingborough propose to construct an electric tramway from Hobart to Huonville, with branches to Port Cygnet, Geeveston, Kingston, and the Upper Huon. The cost of the work is estimated at £2,000 per mile. This proposal is in connection with negotiations pending between the Complex Ores Company and the municipal authorities of Lovett, Franklin, Ranelagh, Huonville and Geeveston for supplying electric light and energy to these towns,

COMPANIES' MEETINGS AND REPORTS.

CASTLEDERG AND VICTORIA BRIDGE TRAMWAY COMPANY.

The half-yearly meeting of the Castlederg and Victoria Bridge Tramway Company was held in the offices, Castlederg, Mr. William King Edwards, D.L. (Chairman), presiding, and the directors reported that there was an increase of £39 16s. 3d. in the receipts and an increase of £104 10s. 6d. in the working expenses. The Chairman explained that the increase in working expenses was chiefly caused by an exceptional charge, amounting to £108 0s, 4d., the greater portion being law costs incurred in defending an action for damages taken against the Company by the relatives of a man who was killed on the country road, and for which they were in no way liable. After paying interest, a sum of £20 9s. 11d. was left to be carried to next account.

UNITED ELECTRIC CAR, PRESTON.

The report of this company, formerly the Electric Railway and Tramway Carriage Works, Limited, for the year ending June 30, states that the works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £2,475, and charging £5,586 15s. 3d. for depreciation, the profit for the year is £8,478 4s. 1d., to which is added £5,333 9s. brought from last year, making a total of £13,811 13s. 1d., leaving, after deducting preference dividend for the six months ending December 31, 1909, £3,000, an available balance of £10,811 13s. 1d. The directors recommend that this amount be dealt with as follows:—To pay the preference dividend less income tax for the half-year ending June 30, £3,000; to pay a dividend of 2½ per cent. less income tax on the Ordinary shares for the year ending June 30, £3,750; to carry forward to next year £4,061 13s. 1d.

YORKSHIRE ELECTRIC POWER.

The 15th ordinary half-yearly meeting of shareholders in the Yorkshire Electric Power Company was held at Leeds, Mr. A. G. Lupton presiding.

The Chairman moved the adoption of the report, a summary of which has already been published. It was particularly interesting, he said, to compare the half-year under consideration with that which ended on June 30, 1908. In the two years the total receipts for the six months had increased from £8,698 to £16,675, but the gross profit had grown from £1,249 to £4,950, and it was to this increasing ratio of profit to revenue that they must look to put the company on a dividend basis. At the February meeting, proceeded the Chairman, it was reported that an overhead main in duplicate was under erection to Castleford in the eastern portion of the company's area. Supply had now been given for several months to a large colliery in that district which was using it for hauling, pumping, ventilating, lighting, etc. Negotiations were proceeding with colliery proprietors both in that and other districts, and a largely increased demand was anticipated in the near future. The Castleford line was also finding a number of other customers anxious for supply. An overhead line was

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now being carried from Brighouse to Sowerby Bridge, where the Distribution Company was being pressed for a supply, and where some important contracts had already been made. A further extension was also being proceeded with in the vicinity of Barnsley. During the half-year further connections had been made to the mains laid or erected before the present year.

At the close of the ordinary meeting an extraordinary meeting was held, at which the shareholders authorised the issue of 20,000 6% cumulative preference shares of £5 each.

In making the proposition, the Chairman (Mr. Lupton) said that a considerable number of shareholders had intimated their intention to take an interest in the issue, and promises to take up over £22,000 of the new shares had already been received. It was interesting to note, added the Chairman, that the directors held either in their own names, or in the names of the firms in which they were partners, over a third of the whole ordinary shares, as well as one-tenth of the second mortgage.

VERA CRUZ ELECTRIC LIGHT.

The third ordinary general meeting was held last week at the registered offices of the company, No. 47, Parliament-street, Westminster, Mr. Vincent W. Yorke (chairman of the company) presiding.

The report of the directors, which was taken as read, was as follows:—The directors are pleased to report that the net profits in Mexico for the year 1909 amount to £19,043 11s., as compared with £9,603 18s. 2d. for the year 1908, being an increase of nearly 100%. The outlook for the year 1910 is favourable. The balance at the credit of profit and loss account, including the balance brought forward from last year, amounts to £2,271 10s. 2d., which it is recommended should be carried forward to next year. In March, 1910, Messrs. Bird, Macdonald, and Pearson retired from the directorate, and Mr. V. W. Yorke, Lord Cowdray, and Mr. H. C. Waters were elected directors. In March, 1910, the directors arranged with the holders of the 6% Debenture Bonds for £300,000, which were redeemable by the company at six months' notice, to exchange these bonds for £250,000 5% First Mortgage Debenture Bonds to Bearer (repayable by the operation of a Sinking Fund commencing in 1916), and £50,000 Ordinary Shares credited as fully paid. The Share Capital of the company was consequently increased to £350,000, and an issue of 5% Bonds to an authorized amount of £300,000 was created, of which £250,000 was immediately issued. The chairman said: The prospects which were referred to in the directors' report for the preceding year, I think I may say, have been fully realised, and a very considerable increase in the business transacted has resulted. This, with the satisfactory saving effected in the costs of operation by the good results obtained from the oil-engine plant has resulted in the net profits showing an increase of nearly 100% over those recorded for the year 1908. I am glad to be able to say that this improvement in the business is to be found in all three departments thereof—namely power, lighting, and tramways—and during the first six months of the present year we can record still further increases in gross and net profits. You will have noticed from the monthly earnings, which are now published in all the leading financial newspapers, that during each month of the present year we have been able to record a satisfactory increase over the results for the corresponding period of 1909. I, myself, have just returned from a visit to Mexico, during which I spent some portion of my time upon the affairs of this company, and I am glad to express my complete satisfaction with the condition of the properties of the company and with the local management. The outlook for the future is, I think, very hopeful. We have just completed the installation of additional arc lamps for the city, and the business which is in sight, and should be connected before the end of the present year, will enable the company to show a satisfactory increase in the profits for the current year, as compared with those of 1909. I think our report fully explains the transactions which took place early this year, when, under the powers given by the trust deed, the old issue of 6% Debentures was redeemed, and a fresh issue was made of 5% Debenture Bonds. The holders of these bonds in March last made a public issue of the same, which was entirely successful. I must apologise for the lateness in presenting the accounts this year, and I think I can undertake that next year they will be forthcoming at a much earlier date.

COMPANIES REGISTERED.

George Hill & Company.—Capital, £4,000, in £1 shares. Objects: To take over the business carried on by George Hill & Company, at 12, Cornbrook Park-road, and 11, Virgil-street, Manchester, and to carry on the business of electricians, engineers, manufacturers, etc. Private company. The first directors (to number not less than two nor more than three) are: A. R. Walmsley, A. K. Walmsley and R. Barron. Qualification, £500. Remuneration as fixed by the company. Registered office, 12, Cornbrook Park-road, Manchester.

W. V. Waite & Company.—Capital, £1,000, in £1 shares. Objects: To carry on the business of constructional, electrical, mechanical, hydraulic, sanitary, civil, marine, railway, mining, consulting and general engineers, engineering and general agents, manufacturers and merchants, etc. Private company. The first directors (to number not less than two nor more than five) are: W. Waite, C. P. Waite and W. V. Waite (managing director). Qualification, £100.

John Turton & Company.—£6,000 (£1) (1,500 6% Cumulative Preference). To take over the business of electro-plate and cutlery manufacturers and dealers carried on by H. E. Buxton and H. E. Bridgwater at Kendal Works, Arundel-street, Sheffield, as John Turton & Company. Private.

William H. Sayer & Company, Ltd., Electrical and Mechanical Merchants.—£500 in 10s. shares. 10, New-street, Bishopsgate, E.C.

Swann Garland, Ltd.—Capital of £5,000 in £1 shares, to carry on the business of manufacturers of and dealers in stove grates, electric light fittings, etc. The first directors are Mr. T. Swann Garland and Mr. M. D. Cooke, both of Sheffield. Private company.

United Lighting and Maintenance Company.—Capital £2,000 (£1). To take over the business of electricians, etc., carried on by S. Mundler at 35, Cock-lane, E.C., as the National Lighting Company. Private. 35, Cock-lane, Snow Hill, E.C.

Furnaces, Ltd.—Capital £12,000, in £1 shares. Objects: To carry on the business of furnace manufacturers, electrical and general engineers, founders, boilermakers, builders, contractors, etc. Private company. The first directors (to number not less than two nor more than seven) are: J. P. O'Donnell and F. E. Jones. Qualification, £100. Remuneration, £50 each per annum. Registered office, Palace Chambers, Westminster.

FINANCIAL NOTES.

Bromley Electric Light and Power.—The directors of the Bromley (Kent) Electric Light and Power Company have declared an interim dividend at the rate of 4 per cent. per annum (2s. per share) on the Ordinary shares for the past half-year.

* * *

Canadian General Electric.—The Canadian Bank of Commerce notify that the directors of the Canadian General Electric Company, Ltd., have declared a dividend of 1¾% on the common stock for the three months to the 30th inst., being at the rate of 7% per annum. A half-yearly dividend of 3½% for the six months ending September 30, 1910, being at the rate of 7% per annum, has also been declared on the preference stock of the company. The transfer books will be closed from September 15 to September 30, inclusive.

* * *

Dumbarton Burgh and County Tramways.—The directors of the Dumbarton Burgh and County Tramways Company, Ltd., announce a dividend of 6% per annum, on the Preference shares for the half-year, making 6% for the year, and carrying forward £3,010.

* * *

Oxford Electric.—The directors of the Oxford Electric Company, Ltd., announce an interim dividend of 6% per annum (3s. per share), less income-tax, on the Ordinary shares for the half-year, payable September 14.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 152, Fleet Street, London, E.C.

CONTRACTS.

EDINBURGH CORPORATION ELECTRICITY SUPPLY.

The Lord Provost, Magistrates and Council invite TENDERS for the following work in connection with their Electricity Supply Station at Dewar Place:—

SPECIFICATION No. 59: STEAM TURBINES, DIRECT CURRENT GENERATORS, and CONDENSING PLANT.

SPECIFICATION No. 60: INTERIOR PARTS OF COOLING TOWERS.

The Plant required consists of Three Steam Turbo-Generators, each of 1,200 kilowatt capacity, with the necessary condensing Plant.

The Interior Parts of the Cooling Towers are required of sufficient capacity to deal with 420,000 gallons of water per hour.

Copies of the Specifications, Forms of Tender, General Conditions, and Drawings can be obtained from the Engineer, Dewar-place, Edinburgh, after Saturday, September 17, upon payment of a deposit of £2 2s. for each Specification, which will be refunded on receipt of a bona-fide Tender and on the return of the Specification, General Conditions, and Drawings.

The Specifications, General Conditions, and Drawings may be seen at, but not obtained from, the Office of Sir Alexander Kennedy, 17, Victoria-street, London, S.W.

Tenders, on the prescribed Form, enclosed in sealed envelopes, and endorsed on the outside: "Electricity Supply, Tender to Specification No. 59," or "60," as the case may be, must be delivered at the Office of the undersigned not later than Monday, the 10th day of October next.

THOMAS HUNTER, W.S.,
Town Clerk.

City Chambers, Edinburgh, September 13, 1910.

CONTRACTS OPEN.

HOME.

BIRMINGHAM.—The Electric Supply Department invite tenders for the supply of 78,000 tons of coal, for delivery between October, 1910, and October, 1911. Particulars from the City Electrical Engineer. September 30.

BRADFORD.—The Electricity Committee invite tenders for the supply of coal for 12 months. Particulars from the Electrical Engineer. September 21.

DEVONPORT.—The Electricity Department invite tenders for twelvemonth's contract supply of coal. Particulars from the Electrical Engineer. September 29.

EDINBURGH.—The Corporation invite tenders for the supply of (Specification No. 59) Steam turbines, D.C. generators, and condensing plant; and (Specification No. 60) interior parts of cooling towers. Particulars from the City Electrical Engineer. October 10.

LONDON, FOR DURBAN.—The Town Council of Durban invite tenders for the supply of elevated jet condenser and piping switchboard, rotary converters, cables and transformers. Particulars from Messrs. Webster, Steel & Company, 5, East India-avenue, E.C., to whom tenders must be sent by September 28.

RHYL.—The Urban Council invite tenders for a year's supply of fuel oil from October 1 next. Particulars from the Electrical Engineer. September 28.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage électrique à Béni-Souef.—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministere de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels. September 26.

HOBART.—The Deputy Postmaster-General will receive tenders up to noon on October 17, for the supply of various telegraph and telephone material (Schedules Nos. 1—9), including cable, instruments, switchboards, battery material, wire, insulators, ironwork, &c. A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). Specification. Direction des Chemins de Fer d'Outre-mer, Lisbon. October 12.

MELBOURNE.—The Deputy Postmaster-General, Melbourne, will receive tenders on October 4 for the supply of telegraph and telephone insulators (Schedule No. 332). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and forms of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, as above.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on October 4, for the supply of telephone material (Schedule No. 363). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. A copy of the specification may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

MELBOURNE.—The Deputy Postmaster-General invites tenders for: (2) Up to 3 p.m. on October 18, for the supply of 23 miles of telephone cable (Schedule No. 284); (3) Up to 3 p.m. on October 18, for the supply of 500 composition insulators (Schedule No. 374); (4) Up to 3 p.m. on October 25, for the supply of 10,000 Cordeau insulators (Schedule No. 373). A deposit will be required with each tender. Local representation is necessary.

SYDNEY.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to 2.30 p.m. on October 5, for the supply of 5,000 porcelain insulators. A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to each of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

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"See things in a better light."

200 to 250 Volts. 32 Watts.
(HALF FULL SIZE).

Brimsdown

PATENT
(COLLOID-TUNGSTEN)

METALLIC FILAMENT LAMPS.

BRITISH MANUFACTURE.

DELIVERY FROM STOCK.

PRICE LIST AND TERMS ON APPLICATION.

Telephone: Gerrard 1728.
Telegrams: "Bulbolite, London."

Head Office and Works:
BRIMSDOWN, M'SEX.

Imperial Lamp Works (Brimsdown) Ltd.,
SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

TENDERS ACCEPTED.

HOME.

COLCHESTER.—The following tenders have been accepted by the Electricity Department: Mellinie & Gouldes, Ltd., 2,500 tons of Kirby slack at 12s. 9d. per ton and Portland 1¼ in. slack at 12s. 10d. per ton; and A. J. Hayward, 2,500 tons of Kirby slack at 12s. 10d. delivered.

LONDON.—The contract for the complete electrical equipment of the Palladium Theatre of Varieties, Argyll-street, Regent-street, W., has been placed with Messrs. Siemens Brothers Dynamo Works, Ltd., who have sublet the wiring work to Messrs. Rashleigh Phipps & Company.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

BEDWAS, MON.: J. T. Jenkins, architect, Porth, Glamorgan. The erection of 240 Houses and 10 Shops on the Glyn Gwyn Estate.

BIRMINGHAM: Town Clerk. Police Station.

CARDIFF: H.M. Office of Works, Storey's Gate, Westminster. Two temporary Waiting Rooms for Labour Exchange at Bute Docks.

COLWYN BAY: J. M. Porter & Elcock, architects. Drill Hall.

DURHAM: Clerk to the Education Committee. New Council Schools at Mount Pleasant, Spennymoor, and Close House (near Bishop Auckland); Manual Instruction Room at Ryhope, and alterations at Broompark Council School.

KEIGHLEY: The Board of Guardians propose extending the Nurses' Home at a cost of about £650.

LEEDS: J. Graham, Secretary for Education. Training College at Beckett's Park.

MIDDLESBROUGH: R. Lofthouse & Sons, architects, Albert-road. Outdoor Shelters and additions to Receiving Block at the Union Workhouse.

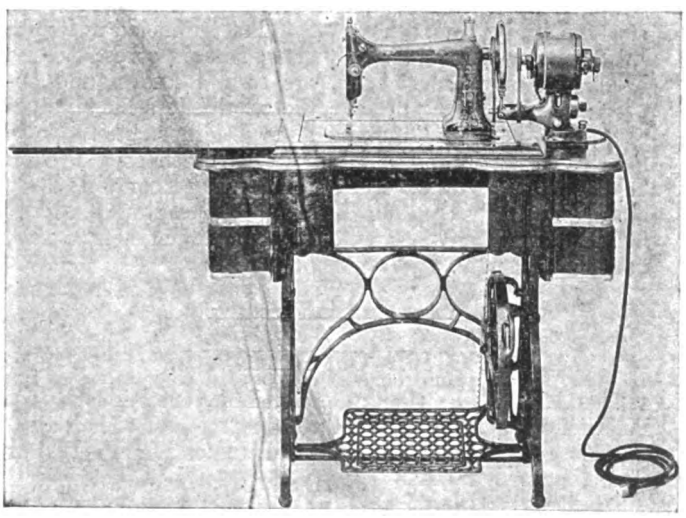
STAFFORD: Director of Education. Handicraft Centre at Tamworth.

WHITEHAVEN: A. Huddart, architect, of Lowther-street. New Bank Premises.

NOTES.

Sewing Machine Motors.

We give herewith an illustration of a large-sized sewing machine coupled to a British Thomson-Houston motor, with flexible attachment for connection with the lighting circuit. The motor is a neat little appliance, completely enclosed and easy to control. Needless to say, it does away with practically all labour, leaving the attention quite free for the actual work in hand. It is such a useful labour saver that it should be brought prominently under the



attention of all householders, as well as professional sempstresses and tailors, by electrical contractors. They are made for both D.C. and A.C., the prices ranging in the former case from £4 5s. to £4 8s. 6d., and in the second from £4 5s. to £4 7s. 6d. The complete outfit comprises motor with bracket, one switch, one treadle pull, one leather driving belt, one rubber belt, one ornamental cover, one screwdriver and necessary wood screws for fixing motor to sewing machine table.

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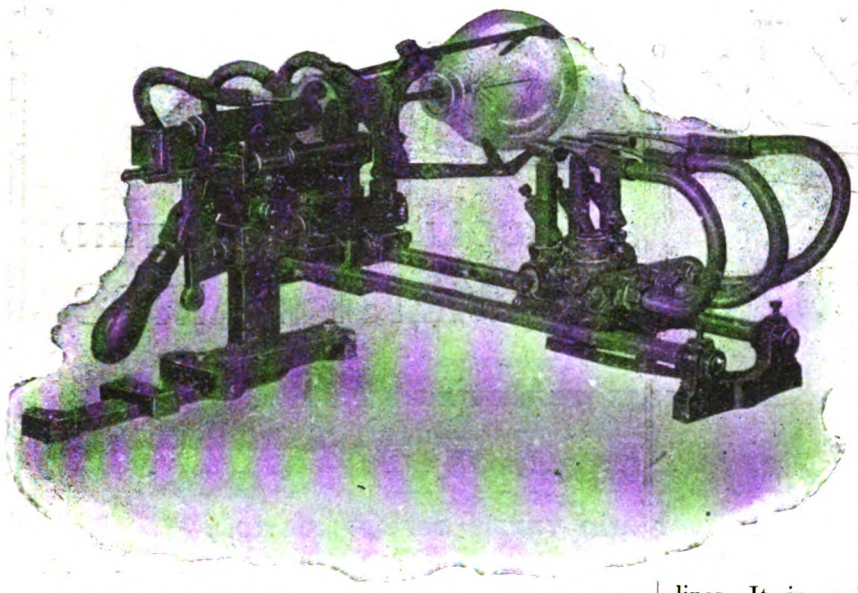
Sealing-in Machine.

The Foster Engineering Company, Ltd., are placing on the market an ingenious sealing-in machine for finishing off metal filament lamps. The machine, which is illustrated herewith, is used by the firm at their arc and glow lamp works, and is found to give a wonderful output, the breakage of filaments being reduced to a minimum even with comparatively unskilled labour. It will be seen that the construction of the machine insures the central support of the lamp, carrying the filaments, always being kept true and central. The gas sealing jet is automatically lowered as each lamp is removed from the frame. The complete machine costs only £5 15s.



Two New Lamps in Three Years.

A correspondent in Doncaster sends to a contractor the following striking testimony to the economy of "Tantalum" lamps:—"Three years ago you put in my electric light installation in Avenue-road with 'Tantalum' lamps. There are ten lights in constant use. Up to now we have only required two new lamps and the lights are as good as ever." Evidently another "Satisfied Consumer"!

"Brimsdown" and Birmingham.

The Metallic Seamless Tube Company, Ltd., of Wiggin-street, Birmingham, whose "Metallic" ironclad switches, Leclanché cells, electric bell wires, flexible cords, electric bells, and other specialities, are so well-known and appreciated, have now become the wholesale selling agents of the "Brimsdown" metallic filament lamps. These lamps hold a very strong position, and are much sought after. The Metallic Seamless Tube Company are carrying large stocks, not only at their Birmingham headquarters, but at their London, Glasgow, Liverpool, Manchester, Leeds, and other depôts.

NOTICE OF REMOVAL.

The A.E.G. Electric Company, Ltd., are removing to Pembroke House, 133-135, Oxford-street, W. Their telegraphic address will still be "Galvanolon, London," but their telephone number is now 8848 Gerrard.

The E. M. F., Ltd., state that in order to cope with the rapidly increasing demand for their lamps, general supplies, also fittings made at their Walsall works, they have been compelled to remove to more commodious premises at 212-213, Upper Thames-street. The business carried on until now at 10, Ironmonger-lane, E.C., and at their stores at King's Cross and Pentonville-road, is now centralised at the above address. The new premises comprise large showrooms, salesroom, head offices, and general stores.

MELBOURNE RAILWAY ELECTRIFICATION.

Australian news to hand shows that the problem of electrification of the Melbourne suburban lines is coming closer towards realisation. Mr. Donald Mackinnon raised the question in the Victorian Legislative Assembly, urging that no time should be lost. He pointed out that the Railway Commissioners spoke about great alterations, duplication of lines, and so on, but he hoped that nothing would be done which would hinder electrification. The matter required immediate attention, and ought not to be remitted to a Royal Commission. Mr. Murray, the Premier, expressed his firm belief that that must come. Nothing would be done in the way of improvement that could not be utilised when electrification came. It was clear from the debate that both the Government supporters and the opposition are entirely in favour of Mr. Merz's scheme which is solely opposed by the Railway Commissioners. As Mr. E. C. Warde, Member for Fleming, pointed out, the Commissioners, criticising Mr. Merz's scheme, said that the traffic would have to increase 33 per cent. to make it economically feasible. Since then, however, the traffic had increased 100 per cent. on some lines, and between 34 and 35 per cent. on the whole of the lines. It is probably that the traffic problem will be solved not only by duplication, but by electrification of both suburban lines and tramways.

PRISMATIC REFLECTORS.

Messrs. Siemens Brothers Dynamo Works, Limited, of Tyssen-street, Dalston, London, N.E., inform us that they will shortly be placing on the market a series of 18 new prismatic reflectors of the holophane type, specially suitable for metal filament lamps and more particularly so for their well-known "Tantalum" lamps. These reflectors will be of handsome appearance and will be of novel design, inasmuch as the prisms thereupon will be of a totally new shape, ensuring great efficiency as well as a good appearance. The reflectors will range in price from 3s. to 12s. each, and the larger and more expensive sizes will be very suitable for Messrs. Siemens' new "Onewatt" 100 c.p. lamps, as well as "Onewatt" lamps of higher c.p., which they hope to place on the market shortly.

NORTHERN LIGHT, POWER AND COAL COMPANY.

The directors of the Northern Light, Power and Coal Company, Ltd., have received a cable from their managing director at Dawson City, Yukon Territory, advising that the power house was completed on August 24, and current successfully transmitted over 44 miles of transmission line, and supplied under contract to responsible power consumers. A subsequent cable, dated 4th inst., states that the electric plant and machinery are running well.

THE TORQUAY TRAMWAYS.

Arbitration proceedings in connection with the Torquay Tramways are now taking place at the Surveyors' Institute, Great George-street, Westminster, Mr. Archibald Lawrence sitting as arbitrator. The question at issue is whether the consent of the Corporation to the installation of the overhead trolley system by the company on certain sections has been unreasonably withheld. The question is complicated because the Board of Trade object to the existing "G. V." contact system.

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
HULL.

PATENTS.

Prepayment Apparatus for the Supply of Electricity.

10934.—1909. J. Hansford, and J. F. Wright, Birmingham. The rotation of the coin carrier spindle causes a clutch connecting the clockwork and coin carrier spindle to come into engagement so that the continued rotation of the spindle winds the clock and simultaneously effects the disengagement of a second clutch which normally connects the clockwork and the timing mechanism for reverse rotation of such mechanism by the clock.

Electric Switches.

15681.—1909. B. and E. Thomas, Hulme. The switch consists of one or more concentric overhung cylindrical contacts operated from the external handle and working in connection with U-shaped fixed contacts arranged concentrically with their axes of symmetry parallel to the axis of the switch, and with their bases and contact studs projecting towards the base of the casing conveniently for the attachment of the wires, combined with one or more separately operated auxiliary switches the axes of which are at right angles to the main axis of the switch.

Circuit Breakers of Electric Welders.

18036.—1909. S. Jevons, and V. D. Green, Birmingham. According to this invention the circuit is automatically broken upon completion of the weld by de-energising the relay magnet or solenoid which releases the switch and opens the circuit. The relay magnet is located in a circuit independent of and separate from the welding circuit.

Electric Furnace for the Continuous Manufacture of Glass.

18118.—1909. M. Sauvageon, Colombes, France. This is an improved furnace of the type in which fusion is obtained by passing an electric current between electrodes immersed in the molten metal. The furnace contains compartments in which the formation and refinement of glass takes place simultaneously. The refined glass flows into compartments in communication with the first compartments. The resistance of the molten glass to the passage of the current has the result of developing a quantity of heat which is utilised to melt and refine fresh quantities of frit.

Contacts for Electric Switches.

18221.—1909. M. B. Field, and Ferranti, Ltd., Hollinwood. This is an improvement in switches of medium and heavy current carrying capacity which are mounted on a panel of insulating material and provided with back connections. The switch jaws on the front of the panel consist of wrought copper strips of high conductivity. These are carried right through to the back and thence direct to the cable socket.

Electric Time Indicators.

18405.—1909. F. Hope-Jones, London, E.C. A pin mounted upon the back stop lever co-operates with a recess in the driving click lever. The back stop is held in engagement with a toothed wheel, driven by the click, when the driving click is withdrawn. The wheel has 120 or 60 teeth according to whether half-minute or whole minute impulses are to be transmitted from the master clock to the time recorders controlled.

Magnetic Separators.

18420.—1909. A. P. Hutchinson, London, W.C. The magnetic fields produced by stationary electro-magnets are so arranged, created and destroyed that the magnetic portion of the material fed into the separator is picked up from the non-magnetic portion and transferred from field to field whilst the non-magnetic portion is being removed by a belt.

Wireless Telephony.

18436.—1909. V. Collin, and M. Jeance, Paris. This apparatus for transmitting sounds without the use of wires has a generating dynamo of variable voltage and constant speed. The negative electrode comprises carbons of very small diameter which work in gas or liquid.

Transmitting Apparatus for Wireless Telegraphy.

18524.—1909. G. Marconi, London, W.C. It has been proposed to employ a transmitter in which the gap between two terminals of the oscillation circuit is more or less bridged at regular intervals by means of bridging pieces in very rapid movement. These bridging pieces consist of studs fixed to a rapidly revolving disc. A greater number of discharges per second can be obtained by increasing the number of pairs of studs on the disc and the speed or rotation of the disc. This is rendered practicable by employing a battery of low resistance having a sufficiently large number of cells connected in series to give the necessary E.M.F. In circuit with the battery is placed an inductance of suitable value to satisfy the necessary working conditions.

Preserving the Lead Supports of Positive Electrodes of Secondary or Storage Batteries from Peroxidation.

18590.—1909. P. Marino, Regents Park, N.W. The supports are coated with a composition consisting of a solution of gutta-percha, to which impalpable powder of antimony and finely pulverised graphite is added.

Switch for Controlling Electric Circuits.

18687.—1909. T. J. and E. Rorke, Barnes. This is an electro-magnetically operated tilting mercury switch in which the circuits of the actuating magnets, as well as any other circuit under the control of the switch, are capable of being controlled by ordinary mercury contact tubes, the circuits being ruptured between the mercury and the contacts. The main current tube is carried by a contact tube which is provided at one end with a pair of contacts and with a mass of mercury or other liquid adapted to rock in the tube in accordance with the actuation of the switch so as to make or break the main circuit. Another tube of similar construction but with a pair of contacts at each end is provided for controlling the circuits of electro-magnets which actuate the switch.

Electrically Operated Fire Alarms.

18771.—1909. W. Leake, and A. V. Rushworth, West Ham. The system comprises a number of audible and visual indicating devices operated in such manner that upon a fire occurring in any part of the system warning will be shown and sounded on all the indicating devices, and the switch operated will be notified on the indicator so that the fireman or attendant will at once know where the fire is located.

Insulator for High Tension Electric Circuits.

25536.—1909. Siemens Bros. & Company, Ltd., & W. Diesel-horst, Westminster, S.W. This insulator which is constructed to withstand high tensional strain and is yet practically inextensible, comprises one or more ebonite hoods connected together by means of a flexible steel rope insulated with rubber. The ends of the rope are secured within the head of the hoods in a solid and effective manner and the insulation covering the rope is connected and vulcanised to the hood so that there is no break in the insulating covering from one end to the other.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Sept. 7	1,508	1,491	+ 17	— 243	27¼	27¼	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Sept. 4	1,248	1,182	+ 66	+ 619	13·68	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	Sept 3	6,565	6,314	+ 251	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 20	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Sept. 3	5,091	5,098	— 7	+ 3,614	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Sept. 11	1,239	1,168	+ 71	+ 27	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Sept. 9	6,451	5,546	+ 905	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Sept. 10	1,454	1,367	+ 87	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Sept. 11	275	266	+ 9	— 2	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Sept. 10	5,352	4,968	+ 384	+ 3,045	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Sept. 11	3,165	3,211	— 46	+ 158	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Sept. 8	593	510	+ 82	+ 1,718	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Aug. 26	1,722	1,677	+ 45	+ 3,382	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Sept. 9	178	138	+ 40	+ 110	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Sept. 9	6,032	5,416	+ 615	+ 1,311	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Sept. 10	1,042	1,010	+ 32	+ 634	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Sept. 3	17,914	17,021	+ 893	+ 12,148	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Sept 10	2,636	2,639	— 3	+ 3,436	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	8·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Sept. 7	133	136	— 3	— 188	4	4	,, 31	7,214	1,968,850	198,415	·9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Sept. 7	1,575	1,467	+ 108	— 569	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,089	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Sept. 4	1,428	1,379	+ 49	+ 58	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Aug. 31	40,468	37,045	+ 3,423	+ 121892	135½	124	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Sept. 10	10,073	9,343	+ 730	+ 6,323	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Sept. 4	15,979	15,536	+ 443	+ 5,032	24½	24½	June 30	680,357	99,816,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Sept. 3	3,850	3,663	+ 187	+ 1,074	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,135	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Sept. 4	6,037	5,601	+ 436	+ 8,170	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	6·04
Southampton Corporation	Aug. 31	1,185	1,223	— 37	+ 488	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 13	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Sept. 3	1,017	978	+ 39	+ 103	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	— 97	+ 1,985	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *h* Half-years' figures.

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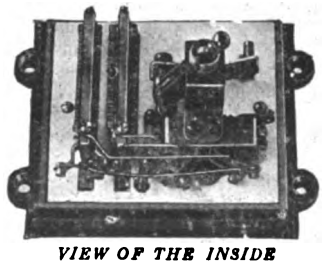

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British Thomson-Houston Co., Rugby.
Cryselco Ltd., Kempston Works, Bedford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Ferabin Lamp and Electrical Works, 118, Queen Victoria-street, London, E.C.
General Electric Co., 71, Queen Victoria-st.
Henley's, W. T., Telegraph Works Co., Blomfield-street, London-wall, E.C.
Imperial Lamp Works (Brimsdown), Ltd., Kingsway House, Kingsway, W.C. Works, Brimsdown, Middlesex.
Stearn Electric Lamp Co., 47, Victoria-st., S.W.

Indiarubber Goods.
Moseley, D., & Sons, Chapel Fields Works, Ardwick, Manchester.
Willcox & Co., 36, Southwark-street, S.E.

Insulating Varnish.
Ammon, A. F., 52, Chapel-street, Blackfriars, Manchester.
Major & Co., Sculcoates, Hull.
Pinchin, Johnson & Co., Ltd., Bevis Marks, London, E.C.

Insulators and Insulating Materials.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Everitt & Co., 40, Chapel-street, Liverpool.
General Electric Co., 71, Queen Victoria-st.
Griffiths Bros., Mack's-rd., Bermondsey, S.E.
Hooper's Telegraph & Indiarubber Works, 31, Lombard-street, E.C., & Millwall Docks.
Johnson & Phillips, Old Charlton, Kent.
Keys, W. H., Hall End Works, West Bromwich.
Macintyre, J., & Co., Washington China Works, Burslem.
Mosses & Mitchell, 69, Chiswell-street, E.C.
Price, Powell, & Co., Bristol.
Traun, Dr. Heinr., & Son, 8, Redcross-street, London, E.C.

Jointing.
John Hudson & Co.'s Successors, 4, Victoria Warehouses, Mansell-street, E.
Everitt & Co., 40, Chapel-street, Liverpool.

Ladders and Steps.
Heathman, J. H., & Co., Parson's Green, S.W.

Lamp Columns for Arc Lighting.
General Electric Co., 71, Queen Victoria-street, E.C.
Johnson & Phillips, Old Charlton, Kent.

Lampholder Makers.
Dorman & Smith, Ordsal Station Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
General Electric Co., 71, Queen Victoria-st.

Lead-Covered Cables.
Callender's Cable & Construction Co., Hamilton House, Victoria Embank't, E.C.
Johnson & Phillips, Old Charlton, Kent.
London Electric Wire Co., Anchor Works, Playhouse-yard, E.C.

Manganesite.
John Hudson & Co.'s Successors, 4, Victoria Warehouses, Mansell-street, E.

Manganese Oxide.
Everitt & Co., 40, Chapel-street, Liverpool.

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NOTES.

Empire Electric Girdle.

Probably the most important event of the Conference of the Institute of Journalists, held in London last week, was the adoption of the following resolution: "That the time has arrived for binding the Empire together with an electric girdle of cheap cables," which was proposed by Mr. Robert McMillan, of Sydney, New South Wales. Mr. Henniker Heaton, M.P., suggested that a Conference of the Postmasters-General of Europe should be called with a view of considering the means of taking over all company owned cables. He pointed out that while it was possible to telegraph all round the Australian coast, a distance of 7,500 miles, 16 words for 1s., and from St. Petersburg to Vladivostock, a distance of 6,000 miles, for 4½d. per word, it cost 2s. per word to telegraph from London to India.

Public Inquiry Question.

The bureaucratic tendency of the Local Government Board in preventing efficient public control over local expenditure has once more been called in question, this time at Bristol. It appears that the Corporation wished to spend £1,372 on constructional work in connection with the removal of the electricity offices and showrooms to the Exchange, and applied to the Local Government Board, who promptly gave their sanction, intimating that they did not consider it necessary to hold a local inquiry. At a Council meeting, Mr. Witty criticised this method of procedure, declaring that a local inquiry should have been held to give the public an opportunity to attend and express their views. It is indisputable that an uneasy feeling is arising over this question, the public seeing that their control is gradually slipping away, being usurped by committees and a bureaucracy. It is unfortunate, because this may have the undesirable effect of unreasonably strengthening the hands of the "economy at any cost" party at the polls, and so arresting progress. The public inquiry helps towards clean, wholesome government, and is a valuable means of educating the public.

Inspector of Electrical Energy.

In conformity with the decision of the Provincial Legislature of British Columbia, Mr. D. P. Roberts, chief electrical engineer, of London, Ontario, has been appointed to the post of Provincial Inspector of Electrical Energy. This is an important step, showing clearly the enormous development of electrical enterprise in the Pacific Province and the expectation of future progress in this direction. The determination is that the natural resources of the country should be developed only in a way to benefit the public and the country as a whole. The anxiety is to encourage enterprise, but to take early steps to prevent the possibility of inimical monopolies being formed. It was the necessity of adopting some such control that caused the Dominion Government to appoint the Hydro-Electric Power Commission; though it came a little late in the day, it is doing good work.

Bombay Factories and Electricity.

Apropos of the Tata Hydro-Electric Power Scheme for Bombay being carried through, our well-informed Calcutta contemporary, the "Indian Textile Journal," says, "The advantages of the electric drive for cotton mills seem to become more and more apparent to Indian millowners. From an attitude of indifference or languid interest, manufacturers have begun to give the subject their earnest attention; many, indeed, are prepared to introduce it on the first opportunity, while some have actually adopted it." The adoption of such projects as the Tata one for Bombay, and the establishment of other hydro-electric undertakings, often in connection with irrigation works, in other parts of India, will greatly hasten factory electrification, and this will mean an immense demand for suitable machinery and appliances, not only for textile mills, however, but for mining and traction as well.

Mining Electrical Engineers.

Excellent progress has been made with the arrangements for the annual meeting of the Association of Mining Electrical Engineers at Newcastle-on-Tyne, on October 7 and 8. The railway companies have consented to issue cheap tickets for members attending the Conference, on presentation of a certificate to be issued from headquarters at Derby. Cheap double journey tickets will also be issued to members staying during the Conference at places not more than 50 miles from Newcastle. The terms will be fare-and-a-quarter for the return tickets.

Electricity and Construction.

Another good instance of the use of electricity in civil engineering construction is afforded by the Los Angeles aqueduct. Particulars of this work were given before the American Institute of Electrical Engineers and have been abstracted by "The Engineer." This aqueduct extends from the intake in Owens Valley to a storage reservoir within 24 miles of the City of Los Angeles, a distance of 240 miles. The first 24 miles of this route is extremely heavy, consisting largely of tunnelling through granite, and including the Elizabeth Tunnel of about 2,700 ft. long. Other heavy tunnelling sections have had to be faced. It was decided to carry out the work by mechanical means as far as possible, and for this purpose electric power was adopted. A hydro-electric station was established in the Pinto Hills on the Division and Cottonwood Creeks.

The Power Station.

This station is some three miles south of the aqueduct intake, where an approximate head of 12,000 ft. is obtained. It is equipped with a plant having a capacity of 600 kw. The plant consists of one tangential wheel direct connected to a 2,200-volt three-phase generator and a battery of transformers, which increase the pressure to 33,000 volts. As the power-house and sub-station will form part of the permanent system, they have been built of ferro-concrete. The cost of the power-house building and equipment, including three cottages, etc., in £42,250. The Cottonwood power-house is 40 miles south from the Division Creek plant. Its equipment consists of two tangential wheels, operating under 1,200 ft. effective head. Each is directly connected to a 750 kw. three-phase 2,200-volt generator. These are connected to the 33,000 volt line through transformers. The power-house and camp complete cost £9,927. The transmission line, which is 151 miles long, is made up of three No. 4 bare copper wires. About one-fifth of the line passes through rough mountainous country. This line has since been extended from its southern end to the aqueduct cement plant, a distance of 17 miles. The object of this extension is to deliver surplus power to the cement plant, with the idea of supplementing the steam plant. The value of synchronous machines for this kind of work has been

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proved, for while delivering a distributed load of 1,000 kw. between the intake and the Pinto Hills, 400 to 420 kw. can be delivered at the cement works 125 miles away at a pressure of 30,000 volts. This refers to when the steam turbines are not connected in parallel with the transmission line. On putting the turbines in parallel and by strengthening the fields of the steam-driven generators, 800 kw. can be delivered at the cement works, the distributed load along the line and voltage drop being the same. There are about 74 step-down transformers connected to the line in banks of two or three. Most of these are of 40 kw. capacity, the remainder being 20 or 80-kw. transformers. Many are of the outdoor type.

Using the Power.

The electric power is used for many purposes besides the actual heavy work of excavation and lifting. There are four electric shovels for excavation in the open country. There are two suction dredges for work in the valleys, each of which is equipped with a 12 in. centrifugal pump, driven by a 100 h.p. 440-volt induction motor, one 40 h.p. motor to run the cutter, another of the same power to run the jetting pump for breaking down the bank over the cutter, and one 20 h.p. motor for operating various hoists. There is also a friction type dipper dredge of 1½ cubic yards capacity, driven by a 100 h.p. induction motor. The step-down transformers in each case are mounted on a float with a rack overhead, which rack supports the choke coils and switch on which the tappings for the transmission line are made. The connection for the transformer float to the dredge is made by means of a three-conductor submarine armoured cable. The cable is stored on a reel on a second float attached behind the dredge, with flexible connections to the dredge, so that the cable is automatically paid out, and when all out the flexible connections are detached and the cable wound up, after which the reel float and the transformer float are towed up to the dredge together. The electric shovels with three-quarter yard buckets and 25 ft. booms used for conduit excavation are of the friction type and are driven by a 75 h.p. 2,200-volt induction motor. The step-down transformers are mounted on trucks, with racks for supporting the choke coils and switches, and with two 10-kw. 2,000–440-volt transformers attached. These transformers supply power to concrete mixers operating in conjunction with each shovel. Twelve three-ton locomotives are in use in this section of the aqueduct. At each end of the Elizabeth Tunnel, which is not supplied from this power system, there is one locomotive of this size and one six-ton locomotive. Some 18 miles of rock and three miles of earth tunnels have to be provided for, and the typical tunnel equipment consists of one air compressor driven by a 100 h.p. 440-volt three-phase induction motor, and one 80-kw. motor generator set providing direct current for electric locomotives, lighting and other work inside the tunnels, power for blowers, and for the machine shop, hoists, pumping, etc. Electric power is also used for sluicing in earthern dam construction, and again for running a tufa grinding mill for the cement works.

Municipal Tramways Congress.

In his presidential address on Wednesday, Mr. C. J. Spencer, general manager of the Bradford Tramways, gave delegates, and even a far wider circle, much to ponder over. He pointed out that the Board of Trade returns for the year 1908–9 showed that there were 2,525·98 miles of electric tramways working, an increase of 61·76 miles. The percentage of net receipts to total capital outlay during the same periods dropped from 6·81 to 6·47, and the percentage of working expensesto gross receipts increased from 62·64 to 63·64. The capital invested in municipal tramways to date is £47,134,754. On this £1,960,501 was paid in interest and £964,010 was set aside for repayment of loans. In view of constant criticism, it is well to find the argument put forward in our last week's leader borne out: the private tramways set aside only 1·05% to meet depreciation and obsolescence; the municipal tramways put aside no less than 3½% for sinking fund, renewals and reserve. It must also be borne in mind that the municipal tramways pay a very heavy amount in rates, really a rather heavier percentage than the private companies. Altogether, Mr. Spencer made out a very good case for the public benefaction of tramways in general and of municipal tramways in particular.

Manchester Section I.E.E.

It is to be hoped that the enterprise shown by the Committee of the Manchester Local Section of the Institute of Electrical Engineers, in opening the Session with a conversazione, will meet with its reward. It is a good idea to bring members together in a friendly way at the opening of a business Session, as this may smooth matters afterwards, and probably this first pleasant introduction will induce many to attend meetings regularly and to bring forward fresh candidates. This conversazione is to take place on Friday, October 14, at the Manchester Whitworth Institute, when, it is hoped, both Dr. Gisbert Kapp and the president-elect, Mr. S. Z. de Ferranti, will be present.

ELECTRICAL INSTALLATIONS IN CHINA.

H.M. Commercial Attaché at Pekin (Mr. W. P. Ker) reports on the foreign trade of China in 1909 as follows: During the year 1909 contracts were given out for new electric light installations at Chungking, Chengtu, Changsha, Nanking and Ningpo, and for more or less important extensions at Shanghai (settlements and native city), Hankow, Pekin, Swatow, Mukden, and other places. Negotiations were proceeding at the beginning of 1910 for a large installation at Hangchow and for installations in several cities in Manchuria. Indeed, there may be said to be an electric lighting project in every city in China (although at Pakhoi the project is stated to have been abandoned in view of the successful introduction of incandescent gas mantles); the only difficulty is to find funds for carrying such projects into execution.

Almost all contracts require to be financed by the contractors, and British firms, finding British manufacturers unwilling to supply plant except for cash down, have sometimes co-operated with German firms, the latter arranging the finance in return for being allowed to participate. Thus several of the contracts mentioned above are for British engines and boilers and German dynamos. Payment is generally spread over a period of two or three years on proper security being given.

In further illustration of the progress in electrical works, it may be mentioned that an electric-tramway scheme for Canton is under contemplation, that a considerable extension of the telephone system in that city has recently been carried out, and that preparations are being made for inaugurating telephone services at Chengtu, at Wuhu, and in the provinces of Kiangsi and Chekiang.

The remarks made above with regard to electric lighting schemes apply also to waterworks, for which there are many projects, perhaps still more difficult to finance. Waterworks are in operation in Shanghai, Hankow, Tientsin, Canton and Pekin, and there are unrealised schemes for Nanking, Chinkiang, Hangchow, Swatow, Newchwang, Tsinan, and probably several other cities. A waterworks system which was started in Chengtu in 1906 has proved a failure.

PERSONAL.

The firm of Messrs. Snell & Moore Ede, consulting engineers, of Caxton House, Westminster, has ceased to exist, these gentlemen having joined the firm of Preece & Cardew, which will now be known as Preece, Cardew & Snell, and will consist of Sir W. H. Preece, K.C.B., F.R.S., A. H. Preece, J. F. C. Snell, Llewellyn Preece, J. H. Woodward, and S. S. Moore Ede.

Mr. W. H. Chatten, electrical fitter apprentice of Sheerness Dockyard, the orphan son of a constable in the Metropolitan Police Force, has within the past three months gained the new Admiralty scholarship in electrical engineering (worth £140 per annum), a Whitworth exhibition of £50, and a "Royal Scholarship," tenable for three years at the Imperial College of Science, South Kensington, with an allowance of £60 per annum. Recently it was announced that he had been awarded the Kent County Science Scholarship of £60 per annum for two years. Chatten has accepted the Admiralty scholarship, and will enter on his studies at the Royal Naval College, Greenwich, next month.

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PRACTICAL ILLUMINATION.*

The Eye as it Affects the Problem.

By John Darch.

The necessity for establishing rational modes of lighting or "illumination," as it is now called, has for many years past strongly impressed several advanced thinkers; but it was only so recently as 1906 that a combined effort was made in America, followed in 1908 in England, in which ophthalmologists, physicists, architects and engineers joined hands—with the willing and invaluable co-operation of continental experts—to further this desirable object; and in the short time that has since elapsed much interest has been aroused, and enormous strides made in the physiological, physical and engineering departments of the subject.

The object of this paper is to show that the principles governing the practice of lighting should be in strict conformity with the hygienic requirements of the eye, and to lay down certain rules thereupon.

The subject of defective vision in school children has already occupied the attention of this Institute, and some striking reports of the examination of children were given at the Southampton, Bradford, and Glasgow Conferences (see Journal, Vols. XXI., p. 95; XXIV., pp. 809 and 814, and XXV., p. 898). It does not, however, appear that any principles of lighting were formulated to obviate the evils pointed out, and it is hoped that this paper may meet that want.

It would ill become me to discuss the pathological or physiological aspects of the question, but as the whole case is really based upon them, a few brief general references will be necessary.

It is too often forgotten that the eye is a physiological organ, that it is adapted to work only within a limited range of light, and that it will resent any infraction of the laws which govern its use. A feature of importance is the direction in which light is received: for untold ages man has been accustomed to an outlook divided by the horizon into a lower half—the soothing green floor of his natural habitat—and an upper half, having a thousand times greater intrinsic brilliancy; in consequence of which, the eye is incapable of enduring light that shines upwards or horizontally; hence daylight reflectors, shop lamps, and other low-placed lights are unnatural and injurious. As, therefore, the eye is constructed for Nature's environment, let us realise the fact that the more our methods approximate to those of natural daylight illumination, the healthier and happier we shall become. The conditions (at once those of daylight, and those essential to good artificial illumination) are:—

(*a*) A sufficiency of light.
(*b*) Perfect steadiness.
(*c*) Effective diffusion and freedom from violent contrasts.
(*d*) A downward direction and preferably oblique, and
(*e*) The colour to be as white as possible.

However readily these conditions may commend themselves, it is not too much to say that they are violated in nearly every lighting installation in the kingdom; whether of gas, electricity, or what not.

That Nature's conditions of lighting are the best is shown by the fact that myopia is unknown in savage life, and extremely rare among seamen and farmers, more particularly in the case of those whose childhood was spent in the open. Defective vision is the outcome of an ill-regulated civilisation, and it is estimated that about half of the studious and close working classes are sufferers therefrom, in one way or another. A morning newspaper in January last, stated that upwards of one-third of the applicants for enlistment in the Territorial forces have to be rejected chiefly owing to defects of vision.

INSUFFICIENT LIGHTING in schools, offices, and workshops is largely responsible for the increase of myopia, astigmatism, and many attendant nerve troubles, but, so far as artificial lighting is concerned, the ever-increasing brilliancy and cheapening of light, properly applied, makes the remedy easy. For reading and ordinary work there should be a minimum illumination of from ·8 to 1·5 foot-candles, for drawing and fine work 3 to 10 foot-candles. There are few needlewomen who have not experienced the eye strain of "black work," forgetting that, owing to its power of absorption, it needs ten times the amount of light required for white work.

HIGH BRILLIANCY in lighting does not, in itself, deserve the hard words which some have applied to it. Like all other forms of energy, light is a good servant but a bad master; it is a source of health and pleasure, and the more we have of it under control the greater the possibilities of good results. But glare from ill-placed and ill-tempered lighting is responsible for much suffering.

The dazzling effect of a source of light may be due to (1) its intensity, (2) its composition, or (3) its contrasts.

1. INTENSITY.—A question, still open for settlement, is the maximum intrinsic brilliancy from any point or surface (and it is the intrinsic brightness and not the total flux of light that counts physiologically) that may be continuously and safely gazed upon. Dr. Louis Bell gives 5 c.p. and Dr. Stockhausen 4 c.p. per sq. in. as the maximum permissible brightness from a hygienic point of view, but Woodwell (U.S.A.) gives ·2 to ·1. This is a wide difference; yet, personally, I have advocated a still lower maximum, viz., ·05 c.p. per sq. in., equal to a 15 c.p. light in a 14-in. opal globe.

Some appropriate intensities of the *intrinsic* brightnesses of surfaces and sources may be useful here:—

8 in. Japanese lantern average ..	·01 c.p. per sq. in.
8 in. opal globe containing 16 c.p. ..	·2 ,,
Open candle flame	3·0 ,,
Sky brightness	4·0 ,,
Incandescent gas mantle	25·0 ,,
Electric carbon filament	450·0 ,,
,, metallic ,, ...	1,000·0 ,,
Crater of electric arc	20,000·0 ,,

The reflection from ceilings and walls of interiors may be from ·0001 to ·01 c.p. per sq. in.

Dr. Stockhausen appears to have taken sky brightness as his basis for a maximum; but it is one thing to have sky brightness overhead, and quite another to have it *vis-à-vis*; probably everyone knows how intolerable the sky is when reclining. I am still of opinion that ·05 c.p. per sq. in. is the maximum intrinsic brightness that one may gaze on continuously; for short periods, however, 0·1 may be comfortable. All lights should be rigorously precluded from the field of vision, or if translucent screens be used these should not transmit more than 0·05 c.p. per sq. in.

Bad lighting is invariably due to the absence of suitable and sufficient reflecting surfaces. If the whole expanse of the sky is needed for the diffusion of sunlight, surely every inch of the ceilings and walls should be made to do similar duty and to yield at least 50% of its incident light. This would give the greatest amount of the most agreeable and serviceable of all light—diffused.

2. COMPOSITION.—Light is a radiation of mixed characteristics, potentialities and varying wave-lengths. I need only refer to the desirability of guarding against the short wave and invisible ultra-violet rays. Fortunately these are readily absorbed in common glass (the commoner and greener the better for this purpose), so that if it be necessary to employ the direct rays of an arc, or other high-temperature light, it should always be enclosed in glass. Lamp trimmers suffer much from these rays. The visible longer wave violet rays are, by comparison, harmless. At the other end of the spectrum are the red and infra red rays; these are troublesome only to the extent of the greater proportion of heat transmitted therewith to the eye.

3. STRONG CONTRASTS.—We can comfortably endure the abundant light of the open air because it is general and completely diffused; but artificial lighting, as it exists, is usually one of violent contrasts, demanding a succession of both pupillary and retinal adaptations, during which the eye is striving to protect itself against intense points of light, the while it is labouring to perecive the details of the darker areas. This is productive of fatigue and injury.

* Paper read before the Royal Sanitary Institute Congress, Brighton.

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It is contrast that makes a lamp which is harmless in broad daylight, brilliant and intolerable at night. In like manner, lights in a darkly decorated room are more troublesome than the same lights in a light room. Professor L. Weber gives 100 to 1 as the maximum permissible contrast, but the commoner contrasts in lighting are nearer 5,000 to 1.

Unless something in the nature of a pyrotechnic display be sought, there is nothing to be gained, but much to be lost when the lights themselves are in the field of vision; as they serve only to defeat the very object of their existence and to destroy visual acuity in the objects illuminated.

On the Need for Photometers.—The eye, alone, is incapable of judging actual intensity in lighting, and some reliable means of ascertaining such intensity is essential to the most elementary proceedings.

The need for legislation in respect of adequate lighting has long been felt. Something has been done in the Factory Act Regulations of 1908, requiring that certain rooms shall be "efficiently lighted." Such an expression is, however, indefinite and difficult to enforce, and, until the amount of light to be supplied can be stated in terms of standard units, such legal enactments offer little hope of success. This should present no difficulty, as we now have convenient and portable instruments, known as Illuminometers, for measuring and indicating in foot-candles the amount of light falling on a desk, bench or other surface. They are at present mostly in use by street-lighting engineers, but one should be in the hands of every factory and school inspector, and every architect desiring good natural and artificial lighting in his buildings.

Practical Suggestions.

There are many ways in which the rules herein laid down may be applied, the choice of which will be guided by taste and circumstances; in this short paper I can but indicate certain useful arrangements.

Let the engineer remember this simple axiom: The purpose and object of artificial lighting is to make properly visible the things required to be seen. This really covers the whole case, but may be interpreted in the following rules:—

1. The lamps or other sources of light should be so arranged that they are not visible from the more frequented or ordinary points of view.

2. The illumination should be sufficient to cause the objects to appeal at once to the eye, but should be free from glare.

3. For general illumination the light should have a preponderating downward direction, freely flooding ceilings and walls, uniformly distributed and fully diffused.

4. Special work at desks, benches, etc., should have special lighting, adjustable in position and power, with opaque shades.

5. The colour of the light should be as pure and white as possible. Monochromatic light should, as a rule, be avoided.

The stages of our theatres are about the only places that are always well illuminated; the scenery and the lighting are each the complement of the other, with the most natural and agreeable results. Now, if architecture has any power to charm, that power can only take effect when it is subjected to suitable lighting. It is curious that this truism is so completely overlooked, as one may see in any public building, sacred or secular. The architects of ancient Rome well knew that it was upon the lights and shadows that their superb art depended.

With regard to the disputed question of Direct *v.* Indirect lighting: always prefer Direct lighting in so far as it will accord with the above rules; Indirect lighting where specially suitable or inevitable; and for the rest, an arrangement of limited obscuration of lights which combines the advantages of the other two.

Shop Fronts and Show Cases.—From the fact that a shop front is viewed from one side only, it becomes a simple and easy matter to properly illuminate it. The business instinct has already grasped the fact that money thus spent is a good investment, for improvements have already taken place in many shop fronts; but the majority are really not illuminated, they are simply invested with obtrusive lights that advertise themselves rather than the goods. I would add that the practice of placing glaring, high-power lamps in the front of shops is especially foolish and dangerous. The City authorities of London issued a regulation a short time since that all shop lights be screened on the outside, but they appear to be slow in enforcing it. The methods of shop lighting are largely responsible for the character and elegance of our streets.

Churches.—The lighting of the average church has, perhaps, more than any other class of building, transgressed the most elementary principles of good lighting. To see anything at all, the worshippers have to peer through a forest of low placed lights, or, at least, to endure the glare of a couple of pulpit lights; and yet in many of our leading churches there is not enough light to read by. One would suppose that the beautiful decorations of a church are placed there to be seen, but in nearly every case, at least at night, the upper two-thirds are lost in gloom, and the lower third consists of a few dazzling points of light that obscure all behind them. A chancel may be effectively lit by means of light behind the chancel arch or other projections: one may instance the sublime effect thus produced in the Guards' Chapel, St. James's Park. Such lighting is restful and soothing, and much more conducive to worship than the mystic gloom (always accompanied by the irritating points of light) which several architects have recently defended on religious grounds.

Concert and Lecture Halls are, as a rule, little better illuminated than churches. Bracket and chandelier lights throughout the hall are frequently troublesome, but those on the platform and orchestra are the principal offenders. In Queen's Hall, London, some of these have been draped with great satisfaction. Lofty halls are best illuminated by direct lighting from the ceiling, by which the architectural and decorative features are more naturally displayed and the vast area of ceilings and walls better utilised for diffusion. Should the surfaces be lightly decorated, ample illumination will be obtained at a minimum of cost for gas or electricity. If grouped, the lights should be in more than one cluster—the more the better—or they may be arranged in lines and panels, but care should be taken that the foremost light does not subtend an angle of more than 30° above the rearmost seat. Additional lighting may or may not be required to this. In other cases the lighting may with many charming effects be distributed throughout the hall. Where the halls are long and the ceilings low, top lighting must be screened.

In Domestic Lighting, unlike the foregoing, the rooms are viewed from every ordinary point, the lights must therefore be placed or screened accordingly. The hard and unpleasant effect of exposed lights should not be obviated by the wasteful expedient of entirely covering the lamps with coloured silk or fancy paper shades, whereby the rooms are left in semi-darkness; but all screens and shades should admit of ceilings and walls being flooded with light. No occupation part of a living-room should have a light of less than 0·3 foot-candle.

In the Drawing Room there should be plenty of light from partially obscured sources, and if it is thoroughly diffused by means of well-illuminated walls and ceilings it will add attraction to the room and its contents.

In Ball and Reception Rooms one should aim at brilliance and pleasing effect, for which glare and dazzle is but a poor substitute. It is hoped that the cumbrous and obstructive chandelier is a thing of the past; there are far better modes of lighting in which it is possible to do greater justice to the attractions of the room and its occupants, to say nothing of avoiding the frequent opthalmic headache. In some cases the lighting may be made to produce soft and agreeable effects of its own, provided they do not interfere with the legitimate lighting of the room.

In the Dining Room the essential feature is the table; and nothing better is than a pendant or pendants, each with a large densely-flounced shade adjusted to a width that will just avoid the eye in sitting and standing. The tops of these shades should be open or fitted with opal glass to illuminate the ceilings and upper walls, and thereby, the room generally. In large or handsome rooms further protective lights will be needed to display the decoration and pictures, and at the sideboard.

As to Bedrooms, many a bed-ridden and other person has suffered from bad lighting. The daintiness and charm

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of a well-furnished bedroom may be greatly enhanced by lighting on the lines laid down, which the one-sided daylight window often fails to do. No lights should be visible from the bed. Fancy lighting and such playthings as fairy lights help to destroy the legitimate attractions of the room. It would be profitable to extend the same principles to the SERVANTS' ROOMS and other parts of the house.

PORCHES, HALLS, AND STAIRCASES can be made very effective at a small cost, not by the addition of fittings however elaborate or quaint, in the confusing light from which one is liable to find stumbling blocks in steps and mats, but by the judicious distribution of lamps that will illuminate ceilings, walls, and architectural features, and render perambulation safer.

STREET LIGHTING is, at present, extremely unsatisfactory; there is no diffusion, no reflection, nothing but a blinding display of lights in a background of darkness, that, amidst motor cars and the like, but serve to bewilder the bravest. Why should not these intense lights be shaded, the exteriors of the buildings as well as the pavements illuminated, and by the encouragement of diffused light the citizen be able to see what manner of place he is in, and to walk or drive comfortably and safely through it? It will have to come by and by.

TRANSPORT OF COAL AND ORE BY ELECTRIC TRACTION. *

By W. C. Brown, A.M.I.E.E.

In dealing with the problem of coal and ore, it is necessary to take into consideration the separate conditions of each mine, or group of mines, before deciding which will be the best scheme to adopt. I do not purpose to analyse the relative merits of the schemes, but will assume that the best has been selected for the special conditions. The principal points of the scheme will be governed by the output of the mine, the working hours, the length of track and gradients. With these details at hand the proper size of locomotive can be determined and the question as regards sub-station equipment, track construction and type of motors for the locomotives decided on, as being most suitable for the work to be done. The whole scheme will depend on the type of motor that is chosen for the locomotives, and it will be as well to discuss these types before going further. The choice will lie between D.C. series motors, polyphase induction motors and single phase A.C. motors.

Fig. 1 shows comparative speed and tractive effort of these motors.

The characteristics of the direct current series motor are so well known that it will not be necessary to discuss them here. As regards the polyphase motor much may be said. Among its good points may be mentioned its superior mechanical design and freedom from breakdown. It requires less daily attention and is generally more reliable. The maintenance costs are lower on this type of motor, and a further advantage can be gained by using higher pressures that would be safe on a direct current series motor.

The disadvantages of a polyphase motor are unfortunately many, when used for traction work. To begin with, the overhead construction is more expensive, as it involves the use of two trolley lines, double sets of insulators, and somewhat heavier poles. At whatever voltage that may be used, mechanical considerations impose a minimum size of copper conductor, and the saving in this respect over the direct current system is not large, as allowance has to be made for the power factor of the motors, which, for a railway motor, would not be high. The speed control of a polyphase motor is very limited and as yet no satisfactory scheme has been put forward to overcome this difficulty. The starting torque is inferior to the direct current series motor, and the smallness of the air gap would be a source of trouble. Two trolley poles or collectors are required, and in practice one trolley pole is found to be sufficiently troublesome where frequent shunting and reversing takes place.

Coming now to the single phase motor. Undoubtedly this type of motor has a large field before it for use on long distance railways, but as very few mines will have a track longer than two miles from the sub-station the advantages of using this class of motor will not be appreciated. It is better than the polyphase motor and closely resembles the direct current series motor in its characteristics. Its efficiency is about 8% lower, but in long lines a higher total efficiency is gained by the use of high voltages and absence of converter apparatus and sub-station gear. A reduced voltage is obtained from a transformer on the locomotive from which taps are taken for the lower voltages required in starting up. This is more efficient than using a starting resistance for this purpose as nothing beyond a transformer loss is incurred.

A possible danger, and one that is experienced sometimes on 500 volt locomotives, is that when the rails are covered with coal dust or sand, the locomotive becomes partially insulated, and when switching on, a person standing on a good "earth" and in contact with the locomotive may receive a severe shock which may prove fatal if high pressure alternating currents are used.

From the above rough outline of the types of motors, it is evident that the best to employ for a mine haulage such as would be required on these fields is the D.C. series type.

The haulage system being the connecting link between the reduction works and the mine, a breakdown may cause the mill to be hung up and a stoppage of all the winding plant and tramming underground, therefore all the working parts of the locomotive should be so designed that repairs can be effected as rapidly as possible.

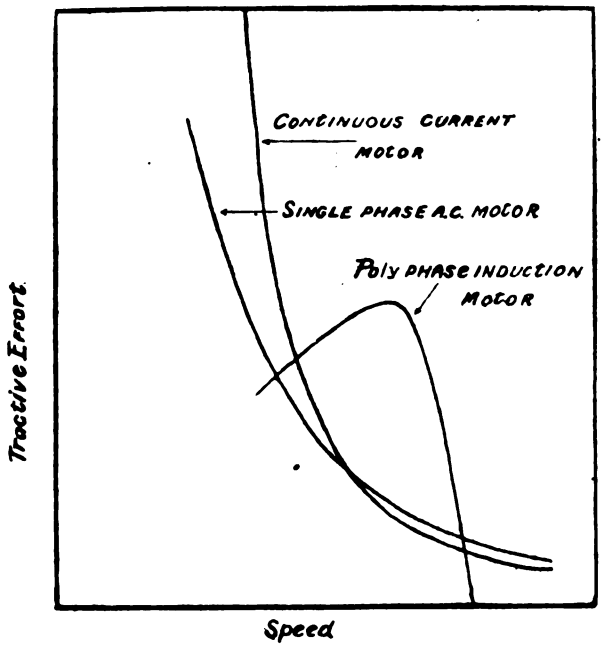

FIG. 1.

The two types of D.C. series motors commonly in use have split and solid field magnet frames. The latter is the sounder mechanical and electrical arrangement, but unfortunately if anything goes wrong the whole motor has to be taken out of the locomotive and the end shields taken off to get at the trouble. One of the most frequent and serious faults is flashing to earth from the commutator and brush gear, and in some types of motor it is necessary to go through the whole process of taking the motor out, etc., to renew the insulation of a brush holder, a job that takes about eight hours, whereas in the case of a split field ring the repair could be easily effected in half-an-hour. The same remarks apply to putting in a new armature or field coil; with a solid ring frame it will take about eight hours, while in a split frame it can be done in three-quarters of an hour, therefore where time is a consideration the divided field magnet ring is the best to have.

Two 20-ton locomotives could haul the ore for a 400 stamp battery and 8 or 9 tube mills, in two 8-hour shifts, from 4 shafts, the furthest shaft being not more than a mile, provided the track is fairly level.

Where steep gradients are encountered nearly all the way to the mill, due allowance must be made and the following formula will apply:—

$$D.B.P. = W.X. \pm \frac{W.2240}{N}$$

* Paper read before the South African Institute of Electrical Engineers.

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Where (W) = Tons.
(X) = Track resistance.
(N) = Inclination (I in N).
(D.B.P.) = Draw bar pull.

In general the conditions are such that the useful work of the locomotive is ·7 of the input at the motor terminals. The complete formula for total H.P. requires being in this case :—

$$1{\cdot}42\left\{\frac{WX \pm W{\cdot}2240}{S\frac{N}{33000}}\right\} = \text{H.P.}$$

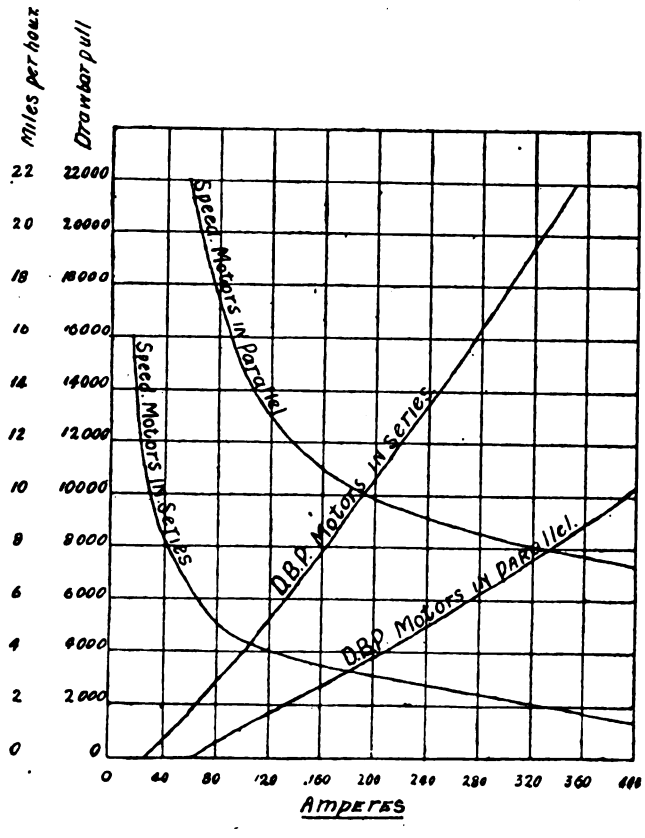
Where (S) = Speed in feet per minute.

Draw bar pull can be obtained approximately from the volts and amperes input as follows :—

$$DPB = \frac{\frac{AV}{746} \times 33000}{\frac{M.P.H. \times 5280}{60}} \times 0{\cdot}7$$

Where (A) = Amperes.
(V) = Volts.
(M.P.H.) = Miles per hour.

The maximum starting effort a mining locomotive is capable of exerting in lbs. is approximately weight of locomotive in lbs. × 0·25, while the normal drawback pull



Characteristic of 20 TON MINE Locomotive
Pinion 14. Gear 81 Ratio 5·78 Wheels 33"
500 Volts.

FIG. 2.

can be taken as weight of locomotive in lbs. ×0·18. The motors of a mining locomotive should be sufficiently powerful to slip the wheels frequently without danger of sustaining injurious effects.

The greatest working economy will be obtained by employing the largest units that can be kept in continuous service. One locomotive of 40 or 50 tons, having a drawback pull of about 18,000 lbs, working 16 hours a day, could do all that is required in the case previously mentioned. In this case, however, where the locomotive will draw say four 20-ton trucks, the expenditure on rolling stock will be greater, as the bin capacity usually provided at the head gears would not be sufficient to store enough ore during the interval or waiting for the return of the locomotive. During this period four 20-ton trucks would be being filled and ready by the time the locomotive returned. A 50-ton locomotive could not run on a smaller gauge than 3 ft. 6 in.

Many arguments can be brought forward as to whether a single unit of 50 tons, or two of 25 tons each, running in tandem as one unit, should be employed. In many cases the curves on a mine are very sharp, and two locomotives in tandem could take these sharp curves where a 50-ton locomotive would fail to do so. Again, in case of a breakdown, the locomotive could be split and run independently during the repair of the other half, thus preserving continuity of service. Both locomotives can be controlled from either, the brakes being all connected together. Another advantage is gained in capital expenditure. With a 50-ton unit it is necessary to keep a spare locomotive in case of trouble, while with the tandem locomotive only half a unit is necessary as spare, and capital cost can be further lowered by the use of lighter rails. Where the railway does not deliver coal to each shaft an advantage is gained in the matter of coaling.

It will be found that a 25-ton locomotive is much handier for this purpose. To take a 50-ton locomotive over the bunkers would mean that the timber framework would have to be heavier than would be otherwise required, an unnecessary capital expenditure. The reserve half unit could be employed to carry out this work. The running and maintenance costs would be slightly higher in the tandem set, but the advantages are in its favour for mining work.

Heretofore, the gauge commonly in use on these fields where electric traction has been employed was from 18 in. to 30 in., but then the weight of the locomotive rarely exceeded five or six tons. These gauges served their purpose in their time, but to-day it is another matter. Huge mills are being erected, and the rapid transit of the ore from the mine to the mill is a very important point.

The gauge adopted is, within limits, governed by the size and speed of the locomotive that is employed, but other points arise that are also controlling factors. The minimum gauge for a 20-ton locomotive is 36 in., but far better results could be obtained by using a 42-in. gauge, which is the standard South African railway gauge. On a group of mines going through the constructional stage the standard gauge will prove to be of great value. Machinery and stores can be delivered direct to any spot where it may be required by the railway company, thus saving a large amount of time and money; while in the matter of coaling the same applies, as the railway company could deliver straight to the bunkers, the steam locomotives travelling over the mining company's tracks.

Liberality in the weight of the rails is good sound practice, and with standard railway gauge not less than 65 lb. rails should be used for a 30-ton locomotive, and 80 lbs. for a 50-ton locomotive. The use of light rails increases the track resistance and maintenance costs of rolling stock and track. Grooves will be worn in the locomotive wheels, and rapid wear and tear will inevitably follow.

A scheme, excellent in all other details, may end in a failure owing (through a mistaken idea of economy) to the rails being too light. Generally, a speed of from eight to ten miles an hour will be found fast enough for a locomotive drawing coal and ore on a mine.

Many details occur to me that are necessary in successfully operating electric locomotives for mining purposes. Many types of controllers can be obtained, but the most suitable is the type so arranged that the driver must start with the motors in series. This is effected progressively, with one handle. In other types it is necessary to put a lever on the series position, then start up, and when speed is attained the starting lever has to be quickly brought back and the series switch put over to parallel, and starting lever again operated until all the resistance is cut out. When starting with a heavy load and using this type of controller, the driver is very liable to blow out his circuit breaker, unless it is set abnormally high. Braking, by reversing the switch and short circuiting the motors, should not be allowed except in the case of extreme emergency and when the ordinary brakes fail. In any case, the ordinary brakes will stop the locomotive quicker, as it is impossible to prevent skidding when braking with the reversing lever. Braking by the motors imposes a severe strain on all the working parts of the locomotive, and very easily leads to a breakdown.

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As regards wheels for the locomotives, my experience has led me to prefer steel tyred wheels to ordinary chilled iron ones. The former will last about three times as long as the latter. The cost of the steel tyred wheels (33 in.) is about £3 more than a chilled iron one of the same diameter. They are more economical to use, as a new tyre can easily be shrunk on an old wheel, whereas a chilled iron wheel when worn down is just about finished.

It will be found advantageous to provide a triangle for turning round the locomotive every week or so, to keep the wear on the wheels even. If this is not done, it will be found that the back wheels get a deep groove in them while the front wheels are hardly worn.

The locomotive shed should be provided with a small travelling crane, in order that quick repairs can be carried out. The pit should also be deep enough to allow a man to stand upright. The under side of a locomotive is not a handy place to work at at the best of times, but by having plenty of working room repairs can much more efficiently be carried out. Much delay can be avoided by carrying a few spares of the most important parts, such as field coils, controller fingers, an armature, brake shoes and gear wheels. The latter especially, as locally made gear wheels cannot be made that will stand up to the severe strains imposed upon them. Before a locomotive leaves the shed the drivers should make, as part of their duty, a thorough examination of their locomotive, the brushes, electrical connections and brakes receiving special attention, while once a week all brasses and working parts should be overhauled and examined by a skilled mechanic. Cleanliness in all D.C. machines is necessary, but doubly so in a railway motor, and neglect of this important detail leads to disaster.

In view of the fact that three-phase current is used almost entirely, some means of conversion must be employed to produce the direct current required for the traction plant. This can be accomplished by using either of the following types of machines: Motor generators, rotary converters, or motor converters. Owing to its low efficiency (88%) the motor generator does not compare very favourably with the other two types. It has, however, several advantages that warrants its use in special cases. With a motor generator any direct current voltage can be obtained, with a wide variation, and this voltage does not vary with the A.C. voltage. A motor generator is self-starting when an induction motor is used. A great disadvantage is that the D.C.E.M.F. varies with the A.C. frequency.

As regards the rotary converter and motor converter, the cost of these machines is about the same. At full load, the rotary converter has 2% higher efficiency, while below half load the efficiencies are more equal. This difference of efficiency is, however, not of great importance, as it is the all day efficiency that affects working costs. The efficiency of the rotary converter on full load is 94½%. It has great overload capacity and excellent commutation, and the voltage is independent of the A.C. frequency. The disadvantages are, fixed voltage in relation to the A.C. pressure and the liability of this class of machine to "hunt." It is also necessary in most cases to use transformers to provide the correct A.C. pressure. With the motor converter a greater variation of the D.C. voltage can be obtained, but this voltage will vary with the frequency of the supply current, not however to the extent of a motor generator. The motor converter is more suitable for high frequencies, and has the advantage of being able to work with high voltage on the induction motor part of the machine. It has greater stability than a rotary converter, and can be operated without the use of transformers. A further advantage is that they require less attention, and, in the writer's opinion, are more suitable than a rotary converter for a mining plant.

In practice it has been found to be satisfactory if the converter output is 0·5 of the total output of the locomotives where four or five are in use. With fewer locomotives of greater horse power this figure may have to be increased.

As an example of the working conditions existing on these mines, the following details of a plant in operation are given.

There is a total length of 4,500 ft. of double, and 4,000ft. of single track; gauge, 30 in.; weight of rails, 45 lbs.; locomotives in daily use, four (one 20-ton, two 7-ton, and one 3½-ton).

Two-ton trucks are in use, which weigh when empty 1·1 tons. Track resistance varies from 35 to 40 lbs. per ton.

Number of tons of ore hauled per month, 103,260.

Number of tons of coal hauled per month; 3,660.

Operating cost of haulage per ton mile, 1·66 pence.

Maintenance cost per ton mile, 0·66 pence.

Operating costs include wages of drivers, natives, station attendants, cost of power, oil and waste. Maintenance includes upkeep of locomotives, trucks, overhead equipment and track. Cost of current, 0·75 pence per kw.h. (The operating cost per ton per mile—1·66 pence—is high, owing to the grade—1 in 40; if the track was flat the cost would be 0·74 pence per ton mile).

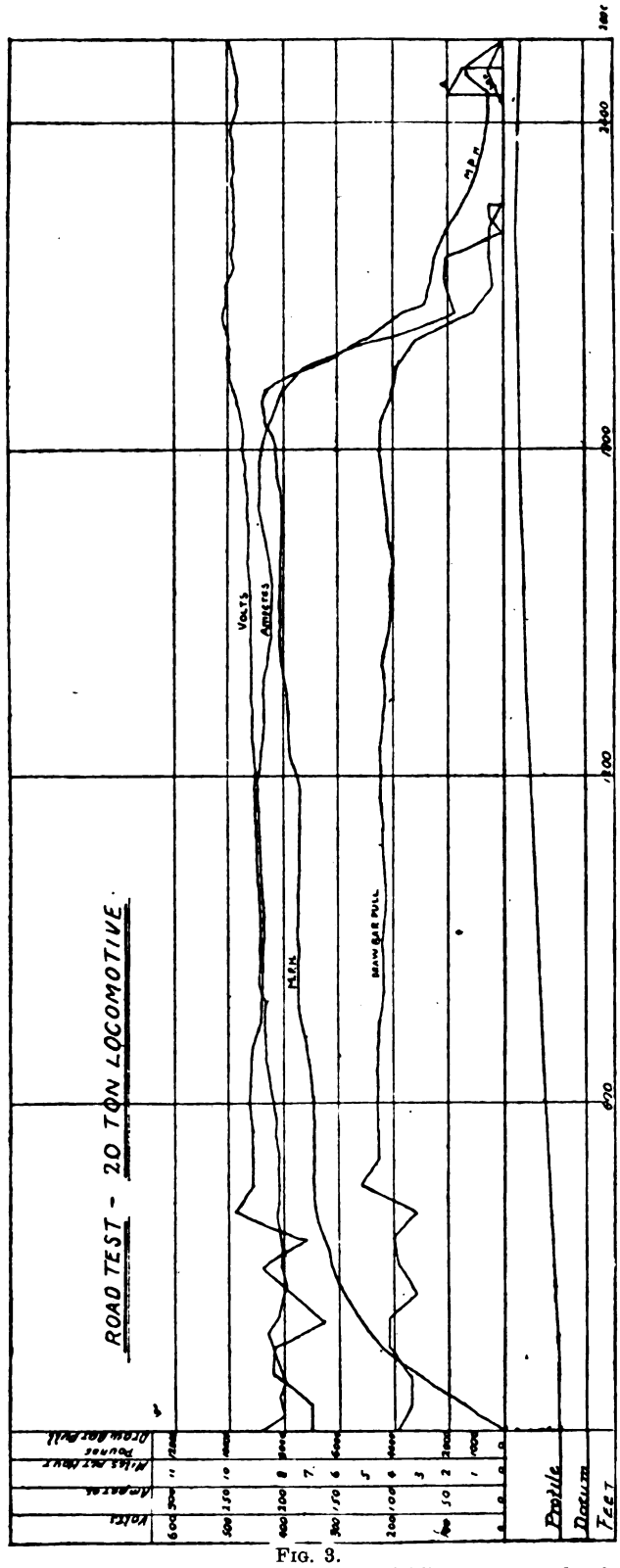

FIG. 3.

Three rotary converters, 85 h.p. each, are installed, two of which are run in parallel, while the third is a standby. No transformers are used for these, they are coupled through the usual switchgear straight on to common bus-bars, which are also used for several other circuits. No trouble is experienced with this arrangement. A small induction motor is used for starting the converters.

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The following details of the 20-ton locomotive (being the most modern) are given :—

The locomotive consists of two 10-ton units coupled together and run in tandem. Each unit is equipped with two 45 h.p. 500 volt series motors. Steel-tyred wheels, 33 in. diameter are used, the gear ratio being 5·78. The locomotives are electrically coupled by means of flexible conductors and multiple plugs, by means of which the locomotives can readily be uncoupled when needed. The total draw bar pull, 7,000 lbs. Speed, 83 miles per hour.

Fig. 2 shows the characteristic of the complete locomotive. From this diagram particulars of any speed and load can be obtained, also the amperes input.

Fig. 3 shows a road test of a loaded trip from the shaft to the crusher station. Weight of ore per trip, 37·5 tons; weight of trucks, 16 tons; total weight, 53·5 tons.

It will be seen from the profile that the service is severe, being a grade of 1 in 40 nearly all the way. Owing to the grade and type of controller in use, it is found to be more satisfactory to start up with the motors in parallel. As the line drop is considerable, acceleration and speed is not so good as it should be.

Very few mines can claim that the electrical plant installed in the first instance was large enough to meet every requirement. This is not the fault of those that laid out the plant, but the tendency of all the mines to increase the monthly tonnage. It presents no great difficulty to instal an extra generator, or a few motors, but the traction plant may prove to be very difficult to increase, when it is desired to run it in the most efficient manner.

It is quite a simple matter to put on an extra locomotive of the same size as those in use, but it would be better policy to purchase new ones of double or treble the weight and scrap the old ones. The extra operating and maintenance charges on several small locomotives would pay for the larger one in a very short time. Therefore, in the first instance provision should be made both in the weight of the rails and sectional area of trolley line and feeders, to deal with the demand that is sure to come for increased tonnage. A liberal margin should also be allowed on the draw-bar pull of the locomotives, if for no other reason than to overcome the extra track resistance of the trucks which, in cold weather, may increase as much at 15 or 20% owing to the stiffness of bearings and truck axles through hardening of the lubricants.

Before concluding, a few remarks might be made on underground traction. A field should be open for this on many of the larger mines. In the early days the size of the mine did not warrant the installation of such plant, neither were the drives suitable. Driving is not directly productive, and no more money than is absolutely necessary is usually spent on this class of work. Consequently the drives are just made large enough for an ordinary truck to go through, and as regards head room, many present will have pretty lively recollections of the number of times they have banged their heads on the hanging wall. These drives usually follow the reef, and are full of curves, many of which are less than 12 or 15 ft. radius; consequently they are not well adapted for electric traction.

In some cases, however, the drives are quite straight, with double tracks laid down and plenty of head room. In such, electric traction could be used with advantage, the locomotives being so arranged that they can be lowered to any level where they may be required.

Owing to the state of underground rails and rolling stock, the track resistance would be greater than on the surface, but there seems to be no reason why the rolling stock should not be kept in the same working condition as obtains on the surface.

THE PRESIDENT: Mr. Brown dealt with a question that is very important to us as Electrical Engineers, and, I think, very important to the gold mining industry, for one notices how few electric traction schemes there are on the Witwatersrand. We see now very large schemes being started which involve huge mills and construction work; also involving, after this work is finished, a great amount of transport. One would like to know why electric traction was not considered in many cases, for it seems to me that electric traction offers such great advantages. Many of our mills are being electrified at the present day, new mills are being erected—in most instances electrically driven—and on many new properties electric hoists are being installed. Why not do away with steam power on the mines altogether, except for smithy and such like purposes.

In this paper I specially notice the author's reference to the 42 in. gauge, and although one may admit that during the early stages of construction work electric traction is not quite so handy, during the later stages there is the advantage of being able to run a steam engines on the rails when it is desired to get material delivered at the spot by the railway authorities. Apart from this, however, the 42 in. gauge is more efficient than the narrower gauge. It is my firm opinion that in all these questions of track and rolling stock, we should treat the matter more on actual railway lines than has been the practice hitherto. One notices along the Reef—it is not the fault of the electrical engineer, by the way—that there are very many small gauges, and not only small gauges, but light rails. It has been too much the habit in the past to buy the track in sections standardised for the ordinary underground and mechanical haulage tracks. Specially is this noticed by anyone who has to deal with the maintenance side of the question. As a rule, the points and crossings are a great point of failure. The track itself is very frequently laid by a man who, though quite competent to lay a track in a crosscut or drive, is not exactly the right man for a locomotive track.

Another point that the author has not touched on is the question of rolling stock—not the locomotive, but the trucks. Sufficient attention is not always paid to this. I remember an experiment which was taken with ordinary mining trucks, showing a resistance to traction of 47 lbs. per ton with ordinary 25 cubic ft. trucks at six miles per hour. That though very high, is often met with. I am a great believer in spending a little more money on the axles. Roller bearings are most useful, reducing the D.B.P. required considerably, without very heavy maintenance cost.

The author says that single-phase traction has a great future before it, but also mentions its efficiency being considerably lower, which, of course, is true, but I do not yet see why it should be put out of court. Most mines have a three-phase supply of some sort. The transformation from three-phase to single-phase is quite easy, using the well-known method of one secondary of a star group of transformers connected in series with the other two. Of course, the voltage is double the voltage across any one coil and the capacity is reduced in the ratio of 2 to 3, but you get rid of rotaries entirely. It is a simple arrangement, and in the present stage of single-phase motors, especially the repulsion motor, I think there is a great hope of its being used.

In the author's examples of a plant in operation, he says that he couples the rotaries direct to the supply without transformers. I do not think we could have that in many cases. It is exceptional, and, it is in this possibility that the single-phase motor scheme, without rotaries, gains.

With regard to the double locomotive, I am not sure myself whether it is so much handier. I have noticed that in most cases where a double locomotive is used, the arrangement has been the result of miscalculation in the first place. If a traction scheme is properly laid out, you will always have two locomotives. It is generally the armature or field that causes breakdowns, and that with a properly arranged car shed, one should be able to replace those parts quickly in two or three hours, during which time one could carry on with the second locomotive. I do not like the double locomotive arrangement. There are two sets of everything, four armatures, four sets of field coils, sixteen wheels with bearings, and gearing accordingly. I should like Mr. Brown to tell us in his reply to the discussion whether in his particular case the double locomotive was the result of pre-conceived design or an afterthought.

I have had some experience with the motor converter. I had to deal with the first that was brought to this country. We had a great amount of trouble at first with the starting and synchronising, and the makers could not help us much. This, however, did not trouble us for long, and the results convinced me that the motor converter is a most satisfactory machine for a mining proposition. The machine I have particularly in view has been running between four or five years, and a stand-by has never been

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used. On one occasion the machine was treated pretty roughly for three or four days after it was installed, as we were in a hurry to get the traction scheme going, but unfortunately, a fault developed on the over head lines outside, which was not absolutely a dead earth. The switch was closed on this four times until the fault showed up dead, and the motor converter never made a sound. A rotary converter will not do that. The great advantage of dispensing with transformers for ordinary voltages makes the motor converter one of the most useful instruments.

LUBRICATION OF CAR BEARINGS.

At the ninth annual conference of the Municipal Tramways Association at Bradford, a report on "Lubrication of Car Bearings," prepared by Messrs. E. Cross (Rotherham) R. L. Acland (Chesterfield), P. J. Pringle (Burton-on-Trent), T. R. Smith (Leicester), was presented and discussed. The report is as follows:

It will be remembered that a discussion was introduced on the subject of the lubrication of car bearings by Messrs. Cross and Acland before the members of the Managers' Section of the Municipal Tramways Association, at Chester, in May last. This subject appeared to be so interesting to the meeting that it was decided by the Executive Committee to ask the authors to form themselves into a sub-committee in order to obtain information throughout the country for purposes of comparison, and also to put forward recommendations from the information that has been so collected.

The sub-committee have acted as desired, and the result is that a considerable amount of information has been collected which it is hoped will prove of interest to the head of every tramway department. A list of questions was compiled and issued by the sub-committee for the purpose of obtaining as much information as possible on the subject of lubrication of car bearings, but that given in response should not only prove of interest so far as the title of this report is concerned, but from a general all-round standpoint.

The sub-committee had for their object in compiling these questions the eliciting of as full information as possible on the following points, viz.: Class of lubricant used in every case and how applied, first cost and life of medium for conveying lubricant to bearings, cost of lubricant, intervals of inspection and cost thereof, horse power of motor, description of bearings and of what composed, amount of wear in bearings, cost of renewals of bearings, and particulars of cost and life of pinions and gear wheels.

Class of Lubricant.

It is interesting to note that the use of oil appears to be finding more favour, for out of a list of 56 tramway undertakings there are 16 towns using oil throughout, while 33 towns are using oil partially, and only 7 towns are adhering solely to grease.

Description of Application.

The method most favoured for application where oil is used is the usual spring pad for the lubrication of armature and suspension bearings. In other cases syphons are used, and in several instances steel and wool waste, moelline, elastic packing, and splash system, find favour relatively in the order in which they are placed. With regard to axle bearings, pads are used to a very great extent, while Armstrong oilers figure largely, and in some cases wool, hair, and steel and wool packing is used.

Cost of Lubricant.

The price per gallon paid for oil varies from 5½d. to 2s. There are quite a number of undertakings who use oil at a price varying from 8d. to 9d. per gallon, and there is also a fair number who pay 1s., 1s. 2d. to 1s. 6d. and 1s. 9d. per gallon. The highest price paid for grease appears to be 18s. 6d. per cwt., others pay 17s. 6d. and 16s., but the usual price appears to be about 12s. 6d. per cwt.

Intervals of Inspection and Replenishing.

There seems to be a considerable advantage in the use of oil so far as the amount of labour required for inspection and replenishing is concerned. Where grease only is used, the necessary period of inspection appears to vary from once each 24 hours to twice per week. Where oil is used the intervals between examination vary from twice a week to once a week, four weeks, and in one instance six weeks, is not considered too long a period for the bearings to run without examination.

Cost of Inspection and Replenishing per 1,000 Miles.

The replies vary greatly, the lowest cost experienced being 2·29d. per thousand miles, and the highest 2s. 10d.

Description of Bearings.

White metal lined bearings find most favour, but there seems to be a considerable variety in the character of the alloys; only seven undertakings use solid bronze bearings unlined.

Miles per 1/16" Wear Measured Across Vertical Diameter.

The information given under this head is considered to be of the utmost importance, and it is interesting to note the number of miles which can be got out of bearings in different towns. As an instance, the following short table of half-a-dozen experiences helps to show the remarkably diverse character of the results obtained:—

A.	Miles per 1/16",	wear	Armature,	5,300	Suspension,	..
B.	,,	,,	,,	5,000	,,	6,000
C.	,,	,,	,,	3,000	,,	..
D.	,,	,,	,,	51,000	,,	16,670
E.	,,	,,	,,	38,500	,,	45,000
F.	,,	,,	,,	38,000	,,	114,000

Life of Bearings in Miles.

The life for armature bearings varies from 84,000, 55,000, 50,000, down to 5,000, but the average life appears to be between 10,000 and 12,000.

Gear Lubricant.

There are eight towns who are using oil for the purpose of lubricating gears; the remainder use grease at about from 14s. to 16s. per cwt.

Life of Gear Wheels.

The life of gear wheels varies considerably in different towns, although the conditions are similar, and the class of gear wheels used are identical, with few exceptions. The highest mileage obtained is 10 to 11 million miles, although there is a reply which states, "None worn out yet." Another answer states, "None worn out after 5½ years use," the lowest mileage obtained being 52,506. Lives of 250,000, 200,000 and 160,000 seem to be fairly common, but many undertakings have had to be satisfied with mileages well under 100,000.

Life of Pinion Wheels.

Here again there is a great difference in the results, and it is interesting to note that in one case mileages of 2¼ to 2½ millions have been obtained, and in another case from 150,000 to 200,000 miles. The lowest mileage obtained is 5,000, but there are instances where a mileage of 165,000 to 155,000 has been experienced. The bulk have had to be satisfied with from 70,000 to 40,000, while there are many well under the lower figure. It is interesting to find that specially hardened pinions have not found a place in the higher mileages, the best result attained being 112,000 miles, but this figure stands quite by itself, other results being much lower.

General.

From the consideration and summarising of the foregoing particulars, the subject of "Lubrication for Car Bearings" has assumed a question of far greater importance to each member of the sub-committee than the mere question of the cost of oil per gallon, grease per cwt., or cost of pads, as the consideration of these costs falls into absolute insignificance compared with the benefits which may be obtained in other ways by a well-designed system of lubrication. Hitherto the provisions made for lubrication have been of the crudest design, and were of such a wasteful character that it was deemed economical to use the cheapest oil on account of heavy leakages, the only other alternative being the use of grease, for the apparent reason that it was not likely to be often in a liquid state, and the loss through leakage was therefore minimised. The sub-committee have been struck with the remarkably short life of bearings in connection with traction work, and even the best instances recorded are short compared with those of stationary motors working under equally disadvantageous conditions

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with respect to heavy intermittent working. In comparing these types against each other there is one adverse circumstance under which the traction motor has to run, as compared with the stationary motor, and it seems that it is in this respect that the comparatively short life of the traction motor bearing is brought about. Take, for example a motor driving a heavy crane in an engineering shop where the atmosphere is fairly loaded with dirt, and still under these circumstances bearings have been known to last for a great many years. In the case of the traction motor, when the car is running, there is a large amount of grit and dirt of the hardest kind, made up largely of fine particles of granite dust surrounding the motors, and unlike the engineer's shop, these particles are not floating about and allowed to fall by their own gravity, but they are driven by a pressure varying as to the speed of the car into any interstices that may present themselves. Consequently, as the present oil or grease chamber is by no means rendered airtight, the grit finds its way into the oil or grease as the case may be.

Formerly, the greaser was considered to be a man of least importance on the tramways' staff, and his job suitable employment for the half-witted, this important work being carried out at dead of night, with little or no supervision, and by those who could scarcely be expected to understand the importance of keeping grease or oil and grit complete strangers to each other. In addition to these disadvantages, it was found necessary to examine and replenish daily, which had a tendency to multiply the evil rather than prevent it, which was, of course, the intention. The sub-committee are of opinion that a system of ring lubrication or its equivalent should be insisted upon in all new motors, and their tangible reason for this recommendation is the already excellent experience of those few undertakings who already have had these motors installed for sufficient time to give a decided opinion. Moreover, the evident advantages of such a system is shown by the fact that as the oil ring is to be relied upon to feed with an ample and generous supply, it does not become necessary to inspect or replenish so frequently, and an allowance of six weeks between inspections is not considered to be too daring. With the "ring" system the wasteage of oil is practically nil, and consequently a higher grade of oil can be used without affecting the cost materially, therefore, with the reduced number of inspections—which by the way would be carried on in the daylight under proper supervision—it would then be well worth while to properly joint all inspection doors in such a manner as to hermetically seal the oil well and bearing.

Given conditions similar to the foregoing, the sub-committee are of opinion that even the best results now obtained should be far surpassed in the future, and should bring the cost per running car mile down in an agreeable manner by favourably affecting a number of items under that head. It may be of interest to know that two members of the sub-committee (Messrs. Cross and Pringle) had been previously experimenting, quite independently and unknown to each other, with a system of chain lubrication adapted to the older type of DK motor, so as to improve the lubrication of these motor bearings and to obtain the advantage of the "ring" system as far as possible under the conditions. Mr. Acland is also carrying out experiments with his Westinghouse (46 M type) motors in a similar direction. Some degree of success has already been attained, and the sub-committee have reason to believe that the experiments will end satisfactorily. Mr. Pringle hopes to have a sample bearing so fitted for inspection by members at the Conference. Replies to the queries have been of a most diverse character, and it would seem that some form of standardization would be an advantage in the methods adopted connection with lubrication of car bearings. Take, for instance, the cost of lubricant, the L.C.C. pay 5½d. per gallon for oil, while Glasgow pay 2s. The sub-committee lay particular stress on the inadvisability of using grease, or a combination of grease and oil, the latter being particularly objectionable on account of the liability of the grease to mix with the oil and so render the pads or other conveying medium inoperative. There is a divergence of opinion as to the most suitable metal to be used for lining bearings, and consequently there is a great difference in the cost per thousand miles in the results under practically similar running conditions. It will prove to be most valuable information for all members to know the reason why Bury can obtain from 10 to 11 million miles out of their gear wheels, and how Glasgow and Keighley have been able to run their cars without renewals of gear wheels from the commencement. With regard to pinions, Bury obtain a life of 2¼ to 2½ million miles, and Glasgow 150,000 to 200,000 miles. Information as to how these remarkable results have been obtained cannot fail to be of considerable interest. It appears to the sub-committee that if co-operation between all undertakings was established with regard to the subject of this report, it might be that an undertaking, although having an excellent experience on the one hand, but unfortunate in other respects, would receive benefit by an interchange of ideas, and thus hope to arrive at the good results obtained by undertakings in other directions. For instance, why should not any undertaking obtain 51,000 miles per ⅛" wear on armature bearings, as in Rotherham? 27,000 miles for suspension bearings as in Belfast? 106,500 miles for axle bearings as in Lincoln? and the excellent mileages obtained by Glasgow, Bury, and Keighley, in respect to gear and pinion?

In concluding their report, the sub-committee desire to take this opportunity of expressing their thanks to the gentlemen who have so kindly contributed the information for the purposes of their report. The sub-committee understand that it is intended to print a summary of the replies given for the purpose of circulation amongst members of the Municipal Tramways Association.

BOOK REVIEWS.

"The Encyclopœdia of Municipal and Sanitary Engineering." Edited by W. H. Maxwell, A.M.Inst.C.E., and J. T. Brown, M.R.San.I. London: Constable & Company, Ltd. Price, 42s. net.

This portly volume is described as "a handy working guide in all matters connected with municipal and sanitary engineering and administration," a sub-title which is fully justified, for the book covers the whole field in a very thorough and painstaking manner. It is a new departure in this branch of technical literature, for all the information is given in alphabetical order, the various articles being contributed by well-known experts in their special domains. Thus we find Mr. H. M. Hobart, M.I.E.E., dealing with "Electricity" (24 long columns) and "Tramways," both subjects, of course, dealt with from the municipal point of view. "Purification by Electrolysis" is a brief but interesting and compact article from the pen of Dr. Samuel Rideal. As an instance of the care with which the book has been edited, it may be mentioned that in the course of a lengthy article on "Refuse Destructors," by Mr. Maxwell, up-to-date statistics are given of the "Money Value of Refuse Fuel at Combined Destructor and Electric Stations." The more important articles are headed by a brief table of their contents, this being followed by references to Acts of Parliament relating to the section. Readers are also assisted by liberal cross-references. Moreover, the articles are copiously and excellently illustrated. It is, undoubtedly, a book which will be found indispensable by every official, teacher and student.

"Elementary Treatise on Physics: Experimental and Applied." By Professor Ganot. Translated by E. Atkinson. Eighteenth edition, edited and revised by A. W. Reinold. London: Longmans. Price, 15s.

We all know "Ganot on Physics," and it is pleasant to find such a sound book still winning popular confidence and renewing its youth. Certainly the work of revision has been most carefully done. There is a considerable amount of new matter, large sections of the chapters on "Telegraphs and Telephones," "Direct and Alternate Current Dynamos," "Electric Oscillations and Wireless Telegraphy," radiation and radio-activity have been re-written. Looking at these sections, it is evident the work is kept well up to date. To prevent the book becoming too bulky, much matter has been deleted. On the whole, the eleven hundred and odd drawings and eight coloured plates and maps are good, but some of the older blocks are not up to the level of the more recent sketches, which gives rather a patchy appearance to certain chapters. However, this 18th edition can be thoroughly well recommended. We note a vast improvement in the index.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Two matters of recent interest in this area have brought into view, by the method of contrast, the advantages of electricity in colliery work. The first is a very animated discussion which has been taking place in the pages of the "North Mail" concerning the treatment of the ponies used underground in the mines. Considerable public attention has been drawn to the matter, and it would appear, from the information made public in that journal, that in the endeavour to win a large amount of coal, considerable ill-treatment and overwork of the ponies has taken place, the average life being somewhat short. It also seems, from some of the remarks, that the Eight Hours' Act has a bad influence in this respect, and the obvious inference is that a system of light electrical haulages would be cheaper in the long run, besides being more efficient and reliable than an animal service. Another incident of the past week which is of peculiar interest, having regard to the distrust which still clings in the minds of colliery engineers with regard to electric winding, is a mishap which occurred at the North Seaton Colliery of the Cambois Coal Company, by which it is reported that coal production to the extent of 6,000 tons per week is affected, and about 1,000 pitmen and lads are laid idle. This was the breaking of a crank on the main winding engine, fortunately, near the completion of one of the trips. The men in the pit at the time had to be drawn to the surface by way of a spare shaft, an operation taking about three hours. If the accident had happened with the cages halfway up the shaft, it would be difficult to estimate the amount of damage. As it is, the incident lays bare the fact that steam winding is not so absolutely flawless as some exponents of the new system would have us believe.

Electrical Engineering on the North-East Coast.

An instructive incident which must be related with due reserve, will show the way in which industrial depression on Tyneside is affecting the electrical industry. Quite recently, one of the firms engaged in one of the trades of Tyneside wanted to make an extension to their electrical equipment, and for this purpose were in the market for cable. Quotations were received from several British firms, and the representative of one of them called on the man who had the placing of the order. He found that none of the British tenders were being accepted, but that the order was going to a foreign firm whose price was 30% below the lowest British tender. The English representative was puzzled, and ventured an enquiry as to the quality of the foreign cable. The answer was illuminating: "My dear fellow, I know what I'm buying: the stuff's muck. But if the insulation will stand up to its work for a year or two it's all we expect. We simply can't afford to buy first-rate stuff with our own market in its present state." This, at least, is the story as quoted to the writer by one who professed to know all the parties concerned.

Electricity and the Building Trade.

One feature of hope in this area is the building trade. It is a fairly general opinion among architects here that the near future will see rapid developments in ordinary house building. There has been a good deal of work already with public and office premises, such as the South Shields Corporation offices, the Newcastle Conservative Club, and Lambton's Bank extensions, in which electric lighting and power has profited, but the development of property seems to be imminent. One architect cynically traced this to Form IV. One development which is certain is the building of a large number of workmen's houses for the accommodation of the men who will be employed at Messrs. Armstrong Whitworth's new works at Walker. There is a movement on foot to establish a "Garden City" in that vicinity, the idea at present being to build about 2,000 houses suitable for various incomes. Lord Howick is mentioned as one of the promoters of the scheme, and it is probable that the Newcastle-upon-Tyne Electric Supply Company, Ltd., will be keeping a benevolent eye upon the matter in the interests of electricity.

A New Use for Wireless Telegraphy.

It will be known to readers of THE ELECTRICAL ENGINEER that the Armstrong College, Newcastle-upon-Tyne, has a powerful equipment for the purpose of wireless telegraphy, and is registered by the Government as an experimental station. Mr. Morris-Airey, one of the staff of the physical department at the college, in lecturing on wireless telegraphy last week, gave a hint which may be useful as a new source of revenue to owners of wireless equipments. He said that messages were frequently received from vessels in the North Sea which were equipped with wireless apparatus, asking details as to the results of the Saturday football matches. This satisfaction of the primal instincts of humanity ought to settle for ever the place of Marconi in history.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

Meetings will be held this week of the local electrical societies to arrange for the forthcoming session. There is every probability of the high standard of interest in connection with the local branch of the Institution of Electrical Engineers being maintained during the coming session. The membership is keeping up well, and there will probably be some accessions. The local president will be Mr. M. J. Railing, in succession to Mr. R. K. Morcom, of Bellis & Morcom, Ltd. Mr. Railing is well known as the head of the General Electric Company at Witton, his period of service commencing 20 years ago. Since that date, he has worked his way through all the departments, and 11 years ago became director. The organising of the works at Witton, now employing about 1,500 hands, has been carried out under his superintendence, and mainly on his initiative. The growth of the firm has been rapid and continuous, and at the present time business in that establishment is in a gratifying state of activity, and, in particular, they are building at the present moment some very large turbo-generators for various English corporations as well as for foreign users. Prior to entering upon his practical work, Mr. Railing studied at various technical schools on the Continent, and subsequently at Finsbury College.

Export Trade.

Birmingham electrical engineers transacting foreign business speak very cheerfully of the improved outlook for the makers of electrical appliances. Business is more brisk than for a long time past, and enquiries tend to increase. A remarkable demand has sprung up for metallic filament lamps for foreign requirements. No great quantity of these are made in Birmingham, but a fairly large number are turned out at Coventry and Rugby. A remarkable business is being done with China. Apparently, the Celestials know a good thing in the way of illumination when they see one, and they are fully alive to the advantage of the metallic lamp, of which they are buying large quantities. A Birmingham engineer who visited China a short time ago states that some of the coast towns, as well as many in the interior having business relations with this country, are much better lighted even than the city of Birmingham, and illuminating improvements are going rapidly forward. Unfortunately, the lead in the supply of these appliances and fittings seems to have been taken by Germany and America; but this country is believed to be recovering lost ground. Progress would be made more rapidly, it is

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said, if the British Consuls were more readily approachable for business requirements, instead of restricting themselves practically to diplomatic duties. However, some little improvement is being noted in this respect.

Canadians in our Markets.

A well-known Canadian-Toronto firm, which has achieved considerable success in the application of electricity to domestic use, is bent on making conquests in this country, and has made a beginning by forwarding to Mr. MacKinnon, the Canadian trade commissioner for Birmingham, specimen of a domestic laundry iron operated by electricity. It is very nicely got up, mainly of nickel steel, and is produced in three sizes. Mr. MacKinnon has introduced it into his domestic establishment, attaching it to one of three electric pendants. The iron is heated almost instantaneously, and is easily attached or removed from the pendant by the insertion of a plug into a socket. The Toronto firm will, of course, have to meet considerable local competition, as the Birmingham electricity department has a number of nice things on offer in this line.

Electricity at the Hereford Hospital.

An appeal has been issued by a Hereford surgeon for public support to a scheme for enlarging the electrical equipment of the Hereford General Hospital. The writer pays a great tribute to the services rendered by electricity to the healing profession. The local hospital, he states, is very well equipped in regard to X-ray apparatus, but requires a dark room for the development of radiographs. Cures have been effected by the X-rays in cancer and other cases, while electric currents have been found advantageous for neurasthenia, rheumatism, anæmia, etc.; but the institution requires an instrument called a multostat for the production of galvanic current. Faradic current, light, cautery, and motor power. In particular, the electrolysis produced by the galvanic current is especially useful to apply drugs directly to an affected joint, instead of through the mouth. Another use of electricity is for massage and the lighting up of cavities. He suggests that other instruments useful, though not absolutely necessary, are the Finsen light, an apparatus for light baths, etc. The appeal is based on the ground that for this kind of treatment it will be necessary to send patients elsewhere, involving expense and suffering to patients, unless the equipments are forthcoming.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

During the past few weeks there have been many rumours of amalgamations with new works and more capital, and nearly every firm has been mentioned in turn. It is well known that more than one well-known Manchester firm of switchgear manufacturers has for the past year been working overtime almost constantly for want of more machinery or the room to put it in. Whether these firms are concerned in the rumoured new works—which have not so far been seen—cannot yet be definitely said, but it is certain they cannot long remain where they are with their rapidly expanding business. Amalgamations, and plenty of them, would be a very good thing for the whole electrical business. The trouble is not that there is not enough work, but that it is badly distributed.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

What has been described as the most elaborate exhibition of its kind yet held in this country was opened in Glasgow by Lord Pentland, on the 16th inst., in the presence of the Lord Provost and a representative gathering. Some 30,000 square feet of floor space is fully occupied by £20,000 worth of smokeless heating and lighting apparatus, which a staff of 300 men have been busy putting in place during the past few weeks. The exhibition is divided into three main sections, viz., gas, solid smokeless fuel, and electricity. Passing by the two former as not being our affair, we find the display of electrical apparatus entirely worthy of the occasion, and the opportunity thereby afforded for educating the public regarding the electrical solution of the smoke problem.

Features of the Smoke Abatement Exhibition.

The Electricity Department of the Glasgow Corporation are to be congratulated on their exquisitely furnished model electric house. This consists of dining room, drawing room, bedroom, kitchen, laundry and bathroom, all the cleaning, lighting, heating and cooking being done by electric appliances. There are no fireplaces or chimneys in any part of the house. The Simplex Conduits Company, the General Electric Company, and the British Thomson-Houston Company have kindly lent the appliances for the occasion. The Glover Lyon ventilating system is installed, and the electric fans are by Keith Blackman & Co. The apparatus in the bedroom includes kettle, milk-warmer, heater for shaving water, curling tongs heater, radiator, and a bed-warmer. The bathroom contains a "Therol" water heater. In this room there are also a Bastian heater, and a shaving water boiler with patent electrically lit shaving glass. The laundry shows a number of electric irons at work, a local laundry delivering a daily supply of materials to be dealt with. The kitchen shows a particularly interesting assembly of heating and cooking utensils, including the General Electric new oven, the Phœnix oven and the Tricity cooker, grills, hot plates, coffee percolator kettles, mincers, grinders, knife cleaners and boot polishers.

As a contribution to the literature of the exhibition, the Electricity Department have compiled an illustrated booklet descriptive of their exhibit, and giving a detailed account of the uses of electrical energy, together with prices, etc.

An admirable feature of the Electricity Department's section is the Information Bureau, where advice and information are given. Enquiries regarding particular pieces of apparatus are referred to the stall of the manufacturer concerned or his agent, so that the firms who have seconded the efforts of the Corporation in organising the exhibition may get a solid return in the way of business.

The lighting of the central passage of the exhibition is by means of 5–10 amp. "Angold" magazine type flame arcs, by the General Electric Company, 2,500 c.p. each, 8 Osram lamps each of 1,000 c.p. round the model house.

Of the 66 stands which comprise the entire exhibition, some 17 are purely electrical. Manufacturers have, as a rule, insisted on exhibiting through local representatives or agents. The following is a list of the chief local firms exhibiting: Messrs. Woodward & Company, of 147–149, Renfield-street, Glasgow, show a large assortment of heating and cooking apparatus, and "Auriga" metal filament lamps by the Westinghouse Company. Messrs. Pettigrew & Stephen, of Sauchiehall-street, Glasgow, have a Singer gang sewing machine at work, motor-driven. This machine, which is on the principle of the pantograph, embroiders six separate articles at once. Mr. Alexander Lindsay, 8, Bothwell-street, Glasgow, has a fine show with the "Mazda" metal filament lamp, together with ovens, irons, kettles, etc. Messrs. Alston, Scott & Company, 50, Wellington-street, Glasgow, exhibit the telewriter at work. This ingenious instrument is shown to be an important electrical adjunct to business life. The Beck Flame Lamp Company exhibit their wares through their agents, Messrs. Edmiston Brown & Company, 224, St. Vincent-street, Glasgow, and their show gives a fine idea of the possibilities of the flame arc. The General Electric Company are well represented, their stall being one of the best. It contains a splendid variety of this firm's newest electrical appliances Messrs. Malcolm & Allan, 499, Eglinton-street, Glasgow, have a very attractive and interesting exhibit of electric cookers, with a chef in attendance giving demonstrations. Theirs is the "Tricity" cooker, and their stand also includes a paraffin electric lighting set, electrical floral fountain, etc. Messrs. Wm. McGeoch & Company, 28, West Campbell-street, have a comprehensive exhibit of both electrical and gas appliances. Messrs. Primrose & Primrose, 199, Bath-street, Glasgow, specialise in artistic fittings, and they also give prominence to various adaptations of the storage battery. Messrs. Mavor & Coulson, of 47, Broad-street, Mile-end, Glasgow, have one of the most substantial

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and interesting shows in the exhibition. Their great specialty is, of course, motors of their own manufacture, with various special features to commend them to the notice of possible purchasers. Messrs. Simplex Conduits, Ltd., in an excellently arranged display of heating, cooking and lighting appliances, deserve to be specially commended. They devote special attention to the uses of electricity in the home. Messrs. Potter & Company, 196a, St. Vincent-street, Glasgow, call attention to "Electroyl" radiators. Messrs. Watson & White, 19, Waterloo-street, Glasgow, are responsible for a large and well designed stall filled with the specialties of Messrs. Spagnoletti & Company, including their "Therol" heater. Messrs. Drake & Gorham, 50, Wellington-street, commend the Quartz system of electric heating in a number of tidy and convenient appliances in a variety of shapes. They also show a cheap and handy vacuum cleaner. With characteristic ingeniousness and no sense of humour, there is a book laid on a chair in the foreground of the bedroom in the gas model house, with the title, "The Old, Old Fairy Tales"! No doubt other cities in various parts of the country will emulate Glasgow in her endeavour to tackle the smoke problem in this practical manner. With the publicity given to the exhibition by the local press, the Glasgow Smoke Abatement Exhibition should have a great influence in not only calling attention to the urgency of the smoke problem, but in educating the citizens as to what has actually been done in various directions towards the abolition of smoke-producing fires of all kinds.

Messrs. Anderson and Munro.

Scottish readers of this column will note with interest the intimation of partnership changes in the electrical contracting firm of Anderson & Munro, of Glasgow, Edinburgh and Dumfries. Established in 1840, they were among the pioneers of the electrical industry, and their standing among their *confreres* was indicated by the election of one partner in 1905 as Chairman of the Scottish Section of the Institution of Electrical Engineers, and of the other in 1906 as President of the Contractors' Association. Mr. Anderson died about 1850, and in 1860 Mr. Thomas Wright became a partner in his stead. In 1884 Mr. Donald Munro retired, and his son, Mr. J. M. M. Munro, became a partner. Now these, in turn, retire, and the business has been acquired by Mr. Thos. B. Wright, who will, doubtless, worthily carry forward its honourable traditions. Mr. J. M. M. Munro, who is a man yet in the prime of life, has no intention of resting upon his laurels, but will devote himself entirely to the consulting work which has hitherto occupied much of his attention. When Mr. J. M. M. Munro entered the business, the electrical was a minor branch of the firm's manufacturing trade. But Mr. Munro's aptitude for scientific studies led to its speedy development, first in telephony, then in electric lighting and power. Among their earlier contracts was the lighting of the Glasgow University house of Sir Wm. Thomson (Lord Kelvin), said by Lord Kelvin to be the first house in the world in which electric light was installed throughout as the sole and permanent illuminant. This was followed by a long series of important undertakings, among which may be mentioned the lighting of Kelvinside—the first of their numerous schemes of district lighting—and the Carstairs Electric Railway, for long the only example in Scotland of electric traction. One of the best known of Mr. Munro's many inventions is his street fire alarm system, which has been so successful in Glasgow and elsewhere. The good wishes of his many friends will accompany Mr. Munro into his new sphere of work.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Plans have been made for erecting an electric long-distance control station at Gumbinnen, taking its power from the river Angerapp at Kampischkehmen, but as the Siemens Schuckert Werke proposed building it on their own account, there was a hitch, but the Bergmann Elektrizitatswerke, of Berlin, have now offered to build and run the station, and there seems little doubt that their offer will be accepted. The contractors are to guarantee 800,000 kw. hours annually, and it is hoped to have the station in operation early next year.

A New Conductor.

The Heddernheimer Kupferwerke and the Suddeutsche Kabelwerke Aktiengesellschaft have put on the market a cheap coppered steel wire incapable of rusting and having great elasticity and tenacity. By heating the monometall, as it is called, without access of air, the iron and copper can be firmly united. The modulus of elasticity is 20,000 kg/mm, equal to that of steel and differing markedly from that of hard copper (13,000 kg/mm only). The specific gravity is less, of course, than that of copper, the difference being about 0·08. The co-efficient of expansion is only 1·22 by 10^{-6}, while that of copper wire is 1·68 by 10^{-5}, a great advantage in favour of monometall. Two brands of monometall are manufactured. Brand A, for electrical purposes, has about 45% of the conducting power of copper. Brand B, for general mechanical purposes, has about two-thirds of the conducting power of Brand A. For cheap durable telephone wires, monometall seems to have a good future before it, but its conducting power is not sufficient to recommend it for carrying high voltage currents.

The Turnitz Long Distance Station.

This station uses brown coal with the best results. Two Melins Pfenniger steam turbines, of 600 h.p. each, drive two rotary current dynamos. The current is of 50 periods and 5,250 volts, at 3,000 revolutions a minute. The exciters of 45 volts are coupled direct. The system at present has a radius of 7½ miles, but it is contemplated to increase it to 19 miles, when the voltage will have to be raised to 30,000. The transmitting wires are carried on wooden masts 30 ft. high, supported by iron and concrete sockets.

Flame Arc Lamps.

The E.T.Z. has an article by P. Hogner on the Korting & Matthiessen arc lamp. He shows that machines which give alternating currents with a sharply rising voltage are the best for arc lamps with flame arc carbons. This is seen especially with currents of low periods, and the rise in the voltage can be favoured by introducing an appropriate resistance.

Electric Water Supply.

The waterworks at Halensee supplies water to the railway stations at Grunewald, Westend and Charlottenberg at the rate of more than a million gallons a day. The water is pumped from deep wells by means of rotary motors supplied by a 225-volt current, transformed from a 3,000-volt current from Charlottenberg. There is a standby centrifugal pump which will deliver 280,000 gallons an hour at 1,460 revolutions. It is driven by one of the electro motors in case of need. The water has to be softened, for which purpose the Dervaux Reisert lime and soda process is employed. The total cost for 1,100,000 gallons per day is about £16 per diem.

Company Affairs.

The second year's trading (1909–10) of the Max Kob Aktiengesellschaft Chemnitz has resulted in a net profit of 239,502 marks, out of which a 10% dividend will be paid on the capital of 1,600,000 marks, 29,126 marks being carried forward. The prospects for 1910–11 are quite satisfactory.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The new factor introduced into central station operations by the metal-filament lamp continues to be a source of discussion in the technical press of this country. In an editorial on the subject in the new number of the "Electrical World" it is pointed out that although the new lamp has been found by the more enterprising class of central-station men to be a powerful means for placing the electric-lighting business on a firm basis through relieving it of the competition from gas lighting, the early period of transition from the carbon to the metallic filament is yet in course. This, the "World" believes, is in part due to the survival of the past Fabian policy of central-station men—to their Micawber attitude toward new situations—rather than to

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actual conditions. "The men holding back are of the class who occasionally at electric light meetings enter feeble protests against the low meter rates of rational charging systems, or against low motor or cooking rates, on the ground that they can see no money in electrical supply at a rate less than 15 or 20 cents per kw. hour. Happily, the awakening of central stations to commercial methods during the past four or five years has resulted in depleting this class considerably; and the competition to which they are increasingly subject from among technical graduates who are taken on by central stations for an apprenticeship training in commercial methods will further clear the field of laggards. Like any important advance in any department of life the change of conditions in the electric lighting field, due to the coming of the tungsten lamp, requires a corresponding change in central station methods, and also of central station personnel where this cannot be adapted to the new order of things. Where this principle has been recognised, the introduction of the tungsten lamp has proceeded smoothly, if we allow that the difficulties overcome were such as must naturally be expected in a radical departure from the old, and, therefore, to be considered merely as incidents of an inevitable transformation rather than feats calling for extraordinary capacity."

Low and High Power.

Discussing the question of candle power, the same writer looks forward to the time when low-power lamps will be as obsolete as candle-lights. The margin for increase in illumination will, he thinks, exist till that of bright daylight is reached, and yearly this margin will be encroached upon. The example set by public lighting—the lighting of main streets, of windows, stores, hotels, etc.—is a powerful stimulus to the inherent desire for artificial illumination everywhere which approaches daylight. The advance in the brilliancy in this class of lighting has grown enormously in the past few years, but its effect with respect to house lighting has been minimised by the universality of the 16 c.p. lamp unit. The introduction of the metallic filament lamp, which will probably occur within the next twelvemonth, will provide an ideal opportunity to raise the candle power. For, aside from the considerations above presented, there will be a powerful commercial one. With a consumption of one-third of that of the carbon filament, the tungsten lamp will bring with it a crisis for the central station. The means to meet this crisis seems to be clearly indicated: The craving for brighter illumination is far from being satisfied, the present electrical incandescent lamp unit is too small, and the new lamp, when placed on the market, should be of a candle-power not less than 25—perhaps as high as 40. Looking back at the present date, we find that the higher candle-power tungsten lamps first introduced not only were of inestimable service to central stations in protecting their interests, but were also appreciated by consumers, who gladly accepted the condition of "More light for the same money." Should there now be a return to the low candle-power unit which was in line of promotion to the obsolete, it will be distinctly unfortunate to the central station, and no real boon will be conferred on the consumer. The "World" would not advocate that the consumer shall be denied any choice in the selection of a lamp; but it believes that every effort should be exerted toward inducing him to use "More light for the same money," and the 40 c.p. and 60 c.p. units are the rational means to this end. In Germany the lesson has been learned from earlier experience with 16 c.p. and 20 c.p. tungsten units, which wherever possible are by concerted effort now being relegated to the rear in favour of 32 c.p. and 50 c.p. units.

An Electric Vehicle Association.

True to the policy of doing nothing by halves, the Electric Vehicle Association of America has been formally organised at a meeting held in the office of Mr. Arthur Williams, of the New York Edison Company. The object of the association is to promote the adoption and use of electric vehicles for business and pleasure purposes. Three classes of membership are provided: active, associate and honorary, and the by-laws provide for branches in centres of local activity. At the meeting on September 1 the constitution and by-laws prepared by a committee appointed at the preliminary meeting were adopted and officers elected as follows: President, Mr. William H. Blood, jun., of Stone & Webster, Boston, Mass.; vice-president, Mr. Arthur Williams, New York Edison Company, New York; treasurer and assistant secretary, Mr. Harvey Robinson, New York Edison Company, New York; secretary, M. C. E. Firestone, Columbus Buggy Company, Columbus, Ohio. The board of directors is composed of the following: Messrs. H. H. Rice, Waverley Company, Indianapolis, Ind.; F. W. Smith, United Electric Light & Power Company, New York City; P. D. Wagoner, General Vehicle Company, Long Island City, N.Y.; Louis Burr, Woods Motor Vehicle Company, Chicago, Ill.; F. L. Dyer, Edison Storage Battery Company, Orange, N.J.; J. T. Hutchings, Rochester Railway & Light Company, Rochester, N.Y.; Louis Ferguson, Commonwealth Edison Company, Chicago, Ill.; W. W. Freeman, Edison Electric Illuminating Company, Brooklyn, N.Y.; F. M. Tait, Dayton Lighting Company, Dayton, Ohio; H. Eames, Studebaker Brothers Company, New York, and C. Blizard, Electric Storage Battery Company, Philadelphia, Pa.

Prevention of Accident.

Discussing the difficulty of maintaining safe and continuous service in a modern power plant when portions of the building or equipment are undergoing changes during reconstruction or extension, particularly in a plant where one side of the circuit is grounded, the "Electric Railway Journal" observes that it may easily happen that an accident will occur through careless work, sometimes in the very act of trying to insulate apparatus for the protection of the construction force. In a typical accident of this kind a new switchboard was being erected in a large railway plant on a gallery above the engine room floor. The old board was located on the floor and the two were tied together electrically by a strip of copper joined to each positive bus-bar. Some of the old panels were removed to the new gallery and additional panels were erected on the same site. About 50 lead-covered feeder cables were run out of the building from the positive bus-bars. To lessen the danger of shock from contact with the lead covering the live parts of the positive circuit to members of the construction force working around the plant the removal was directed of sections of the lead sheathing about 6 in. long from the cables run through the basement. This removal was accomplished by cutting circular channels around the cable coverings, connecting them with a horizontal cut, splitting down the lead and knocking off with a hammer. Upon the substitution of a screw driver for the hammer the former short circuited the conductor and sheath, with serious results. It is important to realise that sometimes even cables and terminals which have been disconnected from a live circuit will for a time retain a sufficient charge through electrostatic capacity to render severe shocks to careless persons. The stators of high-tension alternators are particularly susceptible to this condition, as are long cables of the armoured type, the latter frequently retaining charges for several hours after disconnection. Extreme care in handling all high-tension circuits and apparatus, whether connected to live lines or not, is enjoined by the conditions of modern service.

Electricity as a Tonic.

Some of the New York papers have discovered that the "Electric habit" is getting to be as common as the drug habit, and a doctor is quoted as declaring that "the drink habit and the cocaine habit are mere summer fancies compared with it." But there is one thing to be said in its favour; it is usually beneficial. The electricity habit, according to this authority, is contracted just like any other habit. A few currents are administered during an illness, they strengthen and stimulate, and the first thing the patient knows he finds the tonic indispensable. Even after he gets well he craves the treatment. I know one young woman who makes a fair living by calling at the homes of electricity victims and dosing them with a few shocks from a galvanic battery. "Most slaves to the habit," he says, "have their own batteries, but they are afraid to apply the treatment to themselves. That is practically a groundless fear, for there isn't one chance in a thousand of a person giving himself an overdose. Still, they prefer an experienced hand to manage the current. Not all the electricity fiends are invalids, by any means. Many of them are now as well as they ever were, yet they have become so addicted to the habit that they require the weekly, semi-weekly, or even daily thrills to tone them up."

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Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

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THE FUTURE OF HYDRO-ELECTRICS.

When great activity in any special class of investment is shown on the Stock Exchange, we are not apt to consider that a healthy sign for the industry in question. A fevered anxiety to deal in any particular form of enterprise generally means that the market is being rigged in some way, and a boom engineered in order to carry the ignorant and greedy public off their legs. That means that a good deal of money is bound to be lost, and that many worthless promotions will be foistered on the public, as we have seen in the direction of West Australian and West African gold mines, cycle and motor companies, and the late extravagant gamble in "rubbers," and, of course, the result of such reckless booming and the inevitable loss is that afterwards money is difficult to find for sound investment or legitimate speculation, and so the true interests of the said industry, whatever it may be, suffers by too ardent attention of the stock gamblers. It is, however, quite a different affair when we see a genuine interest shown on the Stock Exchange, a steadily improving demand and gently appreciating prices. For that betokens real business, that serious financiers and their large following of cautious investors, are looking upon that class of stock as a promising investment. Now, as a rule, when this takes place, it is a good thing for industrial development, because it means that it becomes easier to obtain necessary capital for new ventures. Therefore we are pleased to see a growing interest among the investing public for electrical stock, an interest more especially shown in the direction of hydro-electrics. The group of undertakings most in favour are those on the American Continent, both North and South of the United States. So far there has been very little flow of British capital into the many large hydro-electric enterprises within the Republic

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itself, though these are often associated not only with the supply of power and lighting, but the development of land by irrigation. Most of the activity is devoted to the Canadian, Mexican and South American companies. On the aggregate, vast sums of British money have gone to Canada to promote hydro-electric development, and curiously enough the Canadians themselves have been keen in developing hydro-electrics in Mexico and certain of the South American Republics, only seeking the aid of British capital as an afterthought. The "Financial Times" points out that the present activity in these shares is both genuine and justified, there being a real demand for soundly managed concerns, worked, on the whole, economically, and giving fair returns on investments. Our contemporary mentions the following companies: Kaministiquia Power (dealing chiefly with sale of current in bulk), with a ratio of working expenses to income of 14·5%; the Shawinigan Water and Power (sale in bulk, mostly to that strong favourite, the Montreal Light, Heat and Power Company, whose sphere of activity is busy Montreal and the whole Province of Quebec), with a ratio of 14%; Mexico Tramways, ratio 51; Rio Janiero Tramways Light and Power, ratio 49; Sao Paulo Tramway, Light and Power, 36. Others, both Canadian and South American, might be mentioned, but these will suffice. They show very favourably, for it is apparent that the management is excellent, though, possibly, there is room for improvement in the two traction companies mentioned, whose ratio of running expenses may, perhaps, be slightly reduced. We see from our reports of our correspondents that hydro-electric schemes are being constantly promoted in almost every corner of our Empire, as well as in South America. So far, British capital has been attracted for this form of enterprise chiefly to America, and much more can be profitably employed there. But it is well not to lose sight of the fact that equally promising opportunities, if on a smaller scale, occur in Australasia (chiefly in New Zealand and Tasmania), India and South Africa. Natal notably offers a most promising field. The point for us to remember is that if British capital can be secured for this class of enterprise, whether in our own sister countries and possessions beyond the seas, or in foreign countries, it generally means that British brains and British machinery will also be required, so that the public's interest in the subject, though purely from the selfish point of view, bids well for the ultimate prosperity of the industry.

ELECTRIC CONSTRUCTION CHARITIES.

At Wolverhampton, the Electric Construction Company, Ltd., Workpeople's Hospital Committee held their annual meeting last week for the distribution of funds. The total amount available was £125 2s., which was allocated as follows: Wolverhampton, and Staffordshire General Hospital, £70; Hospital for Women, £30; Eye Infirmary, £20; Llanfairfechan Convalescent Home for Men, £3; Institute for the Blind, £1 1s.; Birmingham Ear and Throat Hospital, £1 1s.

HYDRO-ELECTRIC VALUATION APPEAL.

The Lochleven Water Power and Electric Company (Ltd.) appealed against the sum of £35,000, at which they were entered last year. The Court fixed the valuation at £30,500, being 5% of the total admitted capital expenditure, but on account of the works not being fully completed at August 12, the Court restricted the valuation to £10,170 for last year. In respect of this year's valuation the assessors explained that they had fixed it on the principle established in the Court last year of taking 5% on the total capital expenditure, admitted by the appellants as heritage, and applying the principle of last year, they estimated the valuation this year at the sum of £35,000, which they were willing to restrict to £32,000 on an adjustment of the total capital expenditure with the appellants up to date. The appellants claimed to be rated on profits of one year, and led evidence in support of this contention.

The Court in their decision stated that last year in fixing the value at £10,170 the Committee proceeded upon the only method then open to them—namely, a percentage on capital outlay. It had been represented to them that the condition of working during the past twelve months had resulted in a profit of £20,450, against which certain figures had been set that more than absorbed the profit. The Committee were of opinion that the figures relating to the last six months, as compared with the first six months of the year, along with other evidence in the case, showed the prospects for the year 1910–11 were better than for the year that ended on May 15 last, and accordingly they felt justified in coming to the conclusion that the current year would be more successful, and, keeping this in view, they fixed the sum of £7,500 as, in their opinion, a fair assessable value, which sum compared with a rate of, approximately, 1⅛% upon the capital expenditure on the works.

The Assessors asked for a stated case, to be laid before the Court of Session.

BRUSSELS EXHIBITION AWARDS.

The following awards of interest to our readers have been made by the Jurors of the Brussels International Exhibition :—

Class 23.—MECHANICAL PRODUCTION AND UTILISATION OF ELECTRICITY.

Grand Prix.—Kelvin & James White, Ltd., Glasgow; The Morgan Crucible Company, Ltd., London; Parsons & Company, Newcastle-on-Tyne; The Reflector Syndicate, Ltd., London; R. Waygood & Company, Ltd., London.

Diploma of Honour.—Marryatt & Place, London.

Gold Medal.—Lancashire Dynamo and Motor Company, Ltd., Manchester.

Class 24.—ELECTRO-CHEMISTRY.

Gold Medal.—John J. Griffin & Sons, Ltd., London; The Reflector Syndicate, Ltd., London.

Class 25.—ELECTRIC LIGHTING.

Gold Medal.—Faraday & Sons, London.

Silver Medal.—Ropley, London.

Bronze Medal.—J. Dugdill & Company, Manchester.

Class 27.—MISCELLANEOUS APPLICATIONS OF ELECTRICITY.

Grand Prix.—Kelvin & James White, Ltd., Glasgow; R. W. Paul, London.

Diploma of Honour.—Gambrell Bros., London; Nalder Bros. & Thompson, Ltd., London; The Synchronome Company, London.

Class 74.—APPARATUS AND PROCESSES FOR HEATING AND VENTILATION.

Grand Prix.—Home Office.

Diploma of Honour.—Fletcher Russell & Company, Ltd., Warrington.

Gold Medal.—John Griffin & Sons, Ltd., London; Negretti & Zambra, London.

Silver Medal.—Underfeed Stoker Company, Ltd., London; White, Allom & Company, London.

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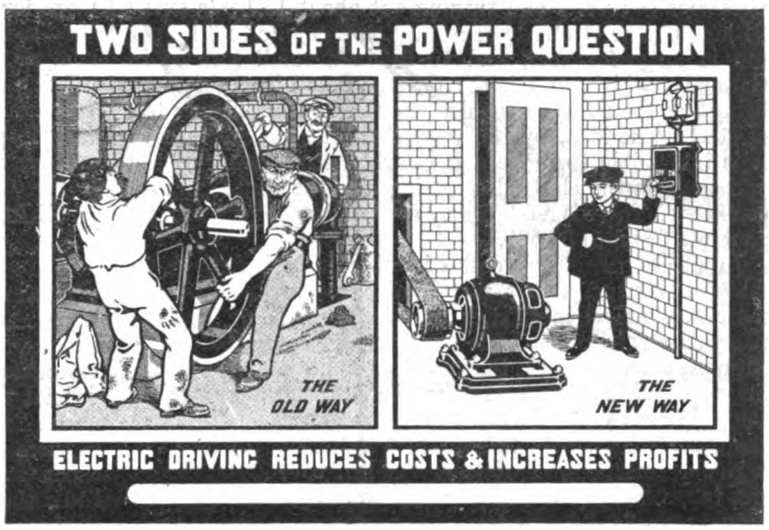
NEW ADVERTISING MATTER.

The Electric Supply Publicity Committee have ready a further issue of publicity matter for the use of Supply Undertakings in London and the provinces. This new batch comprises an electric heating poster, electric heating booklet, power booklet and power mail-cards in two distinct designs. The electric heating poster is of double royal size (25 in. × 40 in.), lithographed in colours from a design by Mr. Chas. Crombie. It is at once a simple and humorous picture, telling an eloquent tale, for it shows a servant taking her ease, thanks to the introduction of electric radiators. The electric heating booklet consists of 6 pages folded so as to fit in ordinary business envelopes, and so be suitable for enclosure to consumers with the accounts, receipts, office correspondence, etc. It contains original drawings of radiators, together with special pictorial vignettes, forming altogether a quite original and attractive folder. The power booklet contains 8 pages of illustrations and letterpress, in a coloured cover. The aim of the letterpress is to emphasise the advantages of electric driving of machinery from a commercial and financial point of view. The title of the booklet is "How to Save Money"; it tells how savings can be realised as regards first outlay, space, labour, running costs, and risks. The first power mail-card in two colours is entitled, "Two Sides of the Power Question," and gives a graphic representation of the ease a motor is started, compared with the strenuous tugging at a fly-wheel and other labour incidental to starting a gas engine. The second power mail-card of strong colouring contains a direct appeal—"Be up to date—Use Electric Power and Save Money." Each of the foregoing mail-cards could be used either as post-cards or as mail-cards, with particulars of power rates, etc., printed on back. The Committee are also anxious to receive preliminary advices of orders for power posters of these two designs. It is interesting to learn that the Publicity Committee have recently decided to extend the scope of their work, and with this view have arranged for the co-operation of representatives from the provinces. The title has therefore been altered, the words "of London and District" now being omitted from the original title—"The Electric Supply Publicity Committee of London and District."

The option of purchasing literature has also been extended to the Colonies, and consignments have already been sent out.



THE ELECTRIC FURNACE: ITS UTILITY FOR CASTINGS.*

By W. S. Gifford.

The electric steel furnace has been causing so much interest in recent years, and so many papers and articles have been written about it, that it is difficult to say anything original on the subject. There is one of its uses, however, which has been comparatively neglected in the technical literature of the day, although it is of great importance, and has been considerably developed in practice. I refer to its application for making castings; and the object of this paper is to give an idea of what has been done in this direction.

RECENT PROGRESS.

The use of the electric furnace in the foundry has long since passed the experimental stage, and British foundrymen must now consider it as a process which is accepted on the Continent, and with which they must reckon in England in the near future. It has been to some extent assumed in this country that it can only be economically adopted in places where the proximity of water power makes electricity extremely cheap, but it must be remembered that cheap power is less important to the steel maker than accessibility, and the two are seldom found together.

The various types of electric furnace have been described so often that it would serve no useful purpose to go over the ground again. I will therefore only take one furnace which has been adopted by many more firms in England, America, and the Continent, than any other, and mention some of its main points. The Heroult furnace is not a complicated electrical contrivance, but a simple tilting basic open-hearth furnace in which the heat is applied by electricity instead of by some fuel which is bound to introduce sulphur and gas. The bottom is lined with dolomite, and the roof with silica, and any man who can line a basic furnace can do this work on the electric furnace. The electrodes are moved up and down by an automatic regulator, and consequently there is very little labour required.

COST OF MAINTENANCE AND REPAIRS.

The cost of repairs is very low. The roof lasts from 100 to 130 heats for refining molten steel. The cost of repairing a roof for a 2½-ton furnace is £3, which amounts to about 2½d. per ton of steel. The bottom is merely fettled with dolomite between the heats, the total cost for refractories being about 6d. per ton. These figures are obtained from South Chicago, where a 15-ton furnace has been in steady operation for 15 months, refining molten steel from a

* Abstract of paper read before the British Foundrymen's Association.

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Bessemer converter and turning out about 15 heats every 24 hours. The electrode consumption amounts to 6 lb. per ton in large furnaces, and 10 lb. in a small furnace in Germany, which, at 2d. per lb. (the cost of manufacture being less than 1d.), is equal to from 1s. to 1s. 8d. per ton of steel. The idea, by the way, that with an arc furnace it is impossible to make a low-carbon steel owing to the carbon from the electrodes getting into the metal is quite erroneous. There is no difficulty at all in keeping the carbon contents down to 0·03%.

In places where the cost of power is high enough to make its consumption a matter of prime importance, the most economical method is to take molten and dephosphorised steel from a basic-lined furnace, preferably of a tilting type, and remove the gases and sulphur in the electric furnace. Even when using the commonest raw materials the sulphur can be brought down to below 0·02%, and the gases completely removed in the Heroult furnace for a power consumption of from 100-kw. to 150-kw. hours per ton, which, at a rate of 0·6d. per unit, works out at from 5s. to 7s. 6d. per ton. This expense, together with that for labour, repairs, electrode consumption, etc., can, as a rule, be more than counterbalanced by the saving in the cost of raw materials. The complete deoxidation is an especially important point, which is not generally sufficiently recognised.

Method of Operation.

Where power is cheap the whole process of melting and refining can be performed in the electric furnace. The procedure is then very simple. Lime and mill scale or iron ore are put in first, and scrap is added. The slag gradually works its way upward through the scrap, and by the time the steel is melted the phosphorus is removed. This oxidising slag is then skimmed off and the sulphur is removed by a basic slag. This slag is extremely basic, and falls to pieces after teeming. The extreme reducing atmosphere of the furnace at this stage is shown by the fact that powdered charcoal put on the surface of the slag remains unburnt for a long time.

The arc on the lime slag forms calcium carbide, which in its nascent condition is very active in combining with sulphur. The presence of calcium carbide can be proved by putting a piece of slag in water, when a strong smell of acetylene is given off, and the slag is seen to be white in colour.

Power Required.

The power required for melting and refining common scrap to 0·02 S. and P. in this way is about 750-kw. hours per ton. For intricate castings the great fluidity of the steel, owing to its complete deoxidation, is very advantageous. Castings of less than 1-25 in. in thickness have been made in Germany for aeroplane radiators. Another point is that the amount of grits can be decreased. Owing to the extreme reducing atmosphere of the furnace the addition of numerous deoxidising agents and other sorts of physic are avoided, so that more homogeneous castings are made, and there are fewer wasters and blow holes. The product obtained either by melting cold scrap or refining open-hearth steel is of the quality of good crucible steel, so that the advantage of the electric furnace over the open-hearth is that it produces a superior steel for the same price.

In comparison with the crucible process the gain of the electric furnace is one of cost. In this case there is a very large saving when making castings, as the cheapest raw materials can be used and the cost of pots is eliminated. In addition to this economy, amounting to several pounds per ton, there is a further saving in the process. The cost of melting in the open-hearth and refining in the electric furnace is considerably less than that of melting in crucibles. In the case of one steel foundry in England, which is engaged principally in making cycle parts and other intricate castings, where the crucible process, working on the best raw materials, has always been used, an electric furnace is now being erected to replace it entirely. In Germany this has been done in many places, and a marked reduction in costs has been effected, while the castings are in no way inferior to those previously made from the best crucible steel.

For the manufacture of heavier castings, where the margin of profits is much smaller, each case requires careful individual consideration. A short refining process in the electric furnace may often be adopted advantageously, more for removing the gases and consequently increasing the fluidity, than for obtaining extreme purity of chemical analysis. In such a case complete deoxidation with partial refining can be obtained for about 100-kw. hours per ton. The cost of this treatment is often counterbalanced by the smaller proportion of wasters, and the decrease in the number of grits and runners.

GLASGOW P.O. TELEPHONE EXCHANGE.

Official Inspection.

At the invitation of the Postmaster-General, on Monday, September 19, a distinguished company of telephone engineers and others interested, gathered in Glasgow from various parts of Europe and the Colonies to attend the Official Inspection of the Glasgow new Post Office Telephone Exchange, which has already been described in detail in these columns. The company were entertained to luncheon at Glasgow by the Peel-Conner Telephone Works, Ltd., the contractors for the Exchange. Mr. H. Hirst, Chairman of the company, presided, and was supported by Mr. Conner, the company's Managing Director. Other gentlemen present included A. M. Ogilvie, Assistant Sec. G.P.O.; Sir John Davey, United River Plate Telephone Company; Bailie Dunlop, Glasgow; H. J. Grewing, Oriental Telephone Company; Hon. Donald Morrison, Attorney General, Newfoundland; W. A. Smith, National Telephone Company; Johnstone Smith, National Telephone Company; W. G. Butler, Director General of Stores for India; G. Morgan, Controller of Stores, G.P.O.; Charles Bright, Commonwealth Government; H. Jackson, Lancashire and Yorkshire Railway; C. H. Wordingham, Admiralty; Walter Webber, Postmaster-Surveyor of Glasgow; F. A. Cortez-Leight, London and North Western Railway; G. C. Stevenson, Telephone Company of Egypt; Professor Biles, Glasgow; E. J. Kist, Rotterdam; S. J. J. Van Emden, The Hague; H. H. Hillebrant, Amsterdam; Douglas Watson, National Telephone Company; W. A. Valentine, National Telephone Company; and John Macfee, General Manager G.P.O. Telephones, Glasgow. A communication was read from Mr. Herbert Samuel, M.P., Postmaster-General, regretting his inability to be present.

Mr. Hirst said that six or seven years ago the Post Office had adopted the policy of taking over the National Telephone Company, and from the first they had realised the desirability of relying on apparatus of home manufacture. Up till then all large exchanges had been imported. As a result of the Peel-Conner Company having been chosen to give a helping hand in this work an entirely new industry had been set on foot in this country. With one of the most brilliant experts in telephonic work in the world as their Managing Director, the Peel-Conner Company had so far been enabled to justify the confidence which the Post Office authorities had placed in them, and this in turn had led to substantial orders from the Colonies. He maintained, however, that the credit was mainly due to the Government officials who had initiated and pursued the policy of having a telephone exchange of British manufacture.

Mr. Ogilvie, Assistant Secretary G.P.O., whose name was coupled with Mr. Hirst's remarks, said that the Glasgow Telephone Exchange as now erected and in operation, was as efficient and as large in proportion to the population as any exchange in Europe or the United States. When the Post Office began to take over the London telephones eight or nine years ago, it had been impossible to get a telephone exchange in Britain. They had adopted a policy intended to put an end to that state of affairs, and in the new Glasgow Exchange they would see that their confidence in placing the work in the hands of a British Company—the Peel-Conner Company—(which is really an off-shoot from the General Electric Company) had resulted in their getting an exchange with the largest switchboard considered practicable, and the whole of the work throughout of the highest standard. The Peel-Conner Company had triumphed over every difficulty in connection with the work, and the new British industry thus set going would undoubtedly advantageously affect other branches of home commerce.

Mr. Conner then gave a brief description of the exchange showing the various advantages of the system and its special features as seen in the new Glasgow Exchange.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

AYR.—This burgh holds the premier place in Scotland for the percentage of consumers of electricity to the population, the total number of consumers at the end of the fiscal year being 1,346, an increase of 69. There was also an increase of 20 power consumers, and an increase of 33% in the units taken for power purposes. The average price obtained for current was: Private lighting, 3·74d. per unit; power, 1·76d. per unit; traction, 1·23d. per unit; public lighting, 2·00d. per unit; average for all units sold, 2·37d. per unit.

BELFAST.—The electric lamps in High-street and Castle-place, which were installed by the Corporation's staff, are now in use and are giving immense satisfaction.

EASTBOURNE.—The Borough Electricity Department have adopted a new tariff. The charge for lighting is to be reduced from 5½d. to 5d. per unit, for outside arc lamps from 4½d. to 4d., for heating and cooking from 2½d. to 1½d. The power rate is to remain at the sliding scale of from 2½d. to 1d. per unit.

EDINBURGH.—A meeting of the Electric Lighting Committee considered the question of the cooling towers in Dewar-place Electric Power Station, Bailie Stevenson, convener, presiding. A report from Sir Alexander Kennedy in regard to the new scheme showed the specifications. The scheme will cost £45,000, and Sir Alexander Kennedy intimated to the committee that he had associated himself in drawing out the scheme with a gentleman who had experience in engineering, architecture, and that the committee could have his assurance that the new cooling towers would be in no way detrimental to the amenity of the district. Sir Alexander also reported that he had seen the Board of Trade officials in connection with the proposed extension to Barnton. The official view is that the Corporation will have to make special application and state the consumers to be supplied outside the city. The surplus of £7,300 from the electricity undertaking working is to be disposed of in reducing the unpaid portion of the cost of the old machinery at Dewar-place. This originally stood at £21,000, and the amount will now stand at £3,200.

GREENOCK.—For the year ending June 30, the Corporation Electricity Department had a total income of £29,016, of which £7,833 was for sale of current for lighting purposes, £15,167 for motor power, and £946 for public lighting. The expenditure amounted to £14,672. After meeting interest and sinking fund contributions and providing for depreciation, there was a net balance of over £2,247. The quantity of electricity generated has risen from 4,421,908 in 1909 to 5,727,183 this year, and the amount sold from 3,495,852 to 5,096,128 units.

INCE.—The Local Government Board have sanctioned the raising of a loan by the Corporation of Wigan to carry out electrical extension to Ince, under the Ince Electric Lighting Order, which the Corporation takes over, paying the District Council £280 for it.

LLANELLY.—Rapid progress is being made by Callender's Cable and Construction Company in laying the cables in connection with the electric lighting. The Urban Council have given the Gas Company six months notice to discontinue the street lighting, and on January 1 the whole of the town will be lighted with the new illuminant, also the market, Athenæum Hall and Town Hall.

LONDON: HACKNEY.—The Electricity Committee have opened commodious and well-equipped showrooms at 306, Mare-street, N.E.

OLDHAM.—The Electricity Committee's minutes contained the following: "The engineer reported the result of an interview he had had with Professor Kennedy with reference to the payment of his commission. He also submitted a letter he had received from Professor Kennedy stating that he was willing to forego any commission now due to him, provided the committee agree to pay to him a commission of 5% for any work which he actually carries out in the future, and only on such work. It was resolved that the arrangement suggested by Professor Kennedy be adopted." This was agreed to. A demand had been made by the Tramway Committee that the Electricity Committee should reduce the price of current from 1½d. to not less than 1d. per unit, and it was said that Stalybridge was supplying current for traction at ·59. Mr. Bolton explained that the committee supplied certain consumers using the day 1d. per unit, but they paid 4d. per unit from 6 to 10 o'clock; therefore the average was much higher than that paid by the Tramways Committee. Moreover, Stalybridge, Mr. Bolton declared, ought not to be taken as an example, for it was losing heavily on its electricity undertaking—£81,000 in seven years, and was now seeking powers to borrow £6,000 to cover a fresh deficit.

SEATON DELAVAL.—Electric cables for lighting are being laid down. Current is being supplied through the Seaton Delaval Co-operative Society, who have made arrangements with the Electric Supply Company. It is hoped that the new arrangement will be in progress before the winter.

SWINDON.—The corporation electricity undertaking shows a better result on the past year's trading than was anticipated. It was first estimated that a surplus of £86 would be realised, but halfway through the year, owing to the reduction in demand for current resulting from the use of metallic filament lamps and depressed trade, it was announced that there would probably be a loss of £15. As a matter of fact, the net surplus is £717, after paying £1,821 interest, £1,795 to sinking fund, and £443 to reserve. The expenses were £4,827, a reduction of £696. Mr. D. R. Merrett having completed his term of apprenticeship, it was decided to advertise locally for an apprenticeship, preference to be given to one who had passed through the higher elementary or secondary schools, or who had received a scientific training.

WARRINGTON.—The Local Government Board has sanctioned the borrowing of £6,257 for the electricity works extension, which is already well in hand.

OVERSEAS.

EDMONTON, ALBERTA.—The Town Council are about to investigate the water-power possibilities of the Athabasca River, with a view to generating electric energy there for use in the city's electric light and street-car systems.

MONTREAL.—Considerable public interest is being taken with regard to the city lighting problem. The Montreal Light, Heat and Power Company's contract expires October 31, and the company some time ago intimated that it desired to have the terms altered. Thereupon the city decided to call for tenders, and this has been done. It was rumoured that the Montreal Light, Heat and Power Company would not tender, but this has now been officially contradicted. It is probable that other companies will tender for parts of the contract.

POTCHEFSTROOM.—The Town Council have under consideration the advisability of raising a loan not exceeding £250,000 as provision for capital expenditure. The greater portion of this is in anticipation of the electric lighting scheme being sanctioned by the Government.

RANGOON.—We learn from "Indian Engineering" that following the arrangement in force in Calcutta, the Burma Public Works Department has recently created a special subordinate establishment for carrying out the electrical work in Government buildings in Rangoon, Maymyo and Mandalay. At the two latter places work will for the present be confined only to the Government houses, as these are practically the only buildings belonging to Government in these stations, fitted with electrical installations, the bulk of the work will be in Rangoon, where almost every public building has electric fans or punkahs and electric lights. The sanctioned staff consists of two senior electricians on Rs. 270—10—420, one assistant on Rs. 160—10—230, and one junior assistant on Rs. 110—5—160. In addition, the men will receive the allowances granted to upper subordinates of corresponding rank. The staff will be on a non-pensionable basis, but will be allowed to subscribe to the general provident fund.

WINNIPEG, MANITOBA.—Permission, which may seriously affect the flow of water in the Winnipeg river and lessen the efficiency of Winnipeg's new power plant at Point du Bois, has recently been given to the Minnesota Power and Canal Company, to divert water from the Birch lake basin at the Rainy River watershed, into the St. Louis River. The water that would be diverted might seriously jeopardise the Winnipeg plant. With a view to protecting the city in this manner, the Board of Control instructed its secretary to forward to the International Waterways Commission a request that the permit be held up until the effect of the diversion on the Winnipeg River can be estimated. The city's power engineers are trying to grasp the full significance of the permit, and will report as soon as possible to the city, when more definite action will be taken. The amount of water which the Minnesota Power and Canal Company is given the privilege to divert is 600 cubic feet per second. The work to divert the water has not been started.

TRACTION.

HOME.

AYR.—The burgh electrical engineer reports that there is a slight decrease in the number of units sold to the Tramway Department, which is, he believes, the result of more economical driving, for which the use of meters on the cars is responsible.

DOVER.—It has been decided to relay part of the track in Snargate at a probable cost of £350. Only £100 has been put down in the estimates, but this amount will be only about

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sufficient to cover the points and crossings. The extra money is to be obtained by saving on other stretches of the track. The borough accountant reports that after going into the matter carefully, he finds the net deficit on the tramway undertaking to be £3,578.

LEEDS.—An agreement has been ratified with Morley for extension of the city tramways to that borough. The total length will be over three miles, but as part of this is not covered by the Morley and Spen Valley Order, application to the Board of Trade and Parliament will be necessary.

NOTTINGHAM.—A proposal was before the Council to try halfpenny fares on two routes. The Chairman of the Tramways Committee, however, pointed out that the present average fare worked out at 1·05d. and the cost at ·92d., so that a halfpenny fare would involve a very heavy loss. They might be able to experiment if the Electricity Committee would supply current at ½d. per unit. The proposal was rejected.

WARRINGTON.—A diversity of opinion between the Tramways and the Paving and Sewerage Committees exists as to their respective financial responsibilities for the upkeep of the tramway track and roadway. It is said that the foundations are defective, and the whole track ought to be re-laid. This would involve an expenditure variously estimated at £4,000, £6,000, £7,000, and even £8,000. At present about £17 per week is being spent on the upkeep.

WEYMOUTH.—With reference to our last week's paragraph, it may be mentioned that the borough Electric Lighting Committee introduced a report for the expenditure of £27,000 on a system of trams within the borough; and the Town Council met with the view of deciding to make an application to the Board of Trade for a Provisional Order. The scheme met with keen opposition from the ratepayers, and the committee withdrew the report. An alternative scheme is to be brought up a month hence.

OVERSEAS.

WELLINGTON, NEW ZEALAND.—In answer to a question in the House of Representatives, the Hon. R. McKenzie, Minister of Public Works, said that the Government has some information in its possession regarding the cost of erection, maintenance, and capabilities of electric railways. Electric motors are gradually replacing steam locomotives, especially on branch lines, where terminal requirements, tunnels, heavy grades, or other special conditions emphasise the advantages to be derived from electric operation. Such a line would be suitable between Beaumont and Roxburgh if the probable traffic would warrant the necessary expenditure on construction.

COMPANIES' MEETINGS AND REPORTS.

DUNDEE, BROUGHTY, FERRY, AND DISTRICT TRAMWAYS.

The profit (including the sum brought forward from last year), and after providing for interest on debenture stock, amounts to £5,070 17s. 3d. From this there falls to be deducted interim dividend paid on preference shares for half-year to January 31, 1910, at the rate of 6% per annum, £1,500, leaving a balance of £3,570 17s. 3d. The directors propose to deal with this as follows:—In payment of final dividend on preference shares at the rate of 6% per annum for half-year ending July 31, 1910, £1,500; to renewals fund, £600; to sinking fund for redemption of debenture stock, £600; to pay a dividend on ordinary shares at the rate of 2% per annum for year ending July 31, 1910, £574 17s. 2d.; to carry forward to next account £296 0s. 1d. The earnings of the tramways remain approximately the same as last year, but working expenses are lower, resulting in an increase of net revenue of, approximately, £422; but for unfavourable summer weather the gross receipts would no doubt have been materially increased, with a corresponding further increase in net revenue.

BRITISH THOMSON-HOUSTON.

The report for the year ended March 31 last, to be submitted to the meeting on the 28th instant, states that a number of improvements and additions have been made at Rugby, the most important being an extension to the incandescent lamp factory, costing £19,000, practically doubling its size and capacity, and an extension to the main factory (largely to take care of the increase in the turbine business) now approaching completion, costing, approximately, £30,000. Another building is being enlarged, the estimated cost being about £11,000. The turbine business of the company continues to give satisfactory results, and many important orders have been executed during the year. The company has made further satisfactory progress in the development of metallic filament (Tungsten) lamps, and, to meet the increasing dmeand, has extended its manufacturing facilities. Following the example of the General Electric Company, of New York, this company has adopted and registered "Mazda" as its trade mark for Tungsten lamps. The company has exchanged licenses with the Osram Lamp Works, Ltd., on all its metallic filament lamp patents. Under the terms of the trust deed securing the issue of the company's debentures, the company had to pay to the trustees on February 28 last the sum of £3,339, to be applied by them in purchasing debentures in the market. Since the closing of the books, debentures of the par value of £3,361 have been purchased, making the total par value of debentures retired to date £10,421. The directors have followed their usual practice of making reserves to cover risks in connection with bad debts, depreciation of shares held by the company, and for other contingencies. The balance-sheet shows a profit of £10,932 as the result of the year's working after paying interest on debentures and on loans, and the directors recommend writing off £1,046 for depreciation of goodwill, patents and licenses; £5,000 for depreciation of Rugby factory; £1,312 expended during the year on improvements to the Rugby factory; £500 for depreciation of office furniture and store-room equipments; and £2,825 for depreciation of apparatus, etc., leaving a balance of £248, which, together with the previous year's balance, makes the total amount to be carried forward £2,599.

MANILA ELECTRIC RAILROAD.

Of the many American enterprises which have sprung up in Manila since the annexation of the Philippines by the United States, the Manila Electric Railroad and Lighting Corporation is one of the most important. The Corporation, which was incorporated in 1903, and which has an issued capital of $5,000,000, with a bonded debt of $5,512,000, owns (1) the entire stock and bonds of the Manila Electric Railroad and Light Company; (2) all the capital stock of the Manila Suburban Railways Company, and (3) more than 98 per cent. of the capital stock of La Electricista, a Spanish company conducting an electric lighting business in Manila. The Manila Electric Railroad and Light Company is the owner of a 50-year franchise granted in March, 1903, by the Municipality of Manila, and operates all the electric railways in Manila, in which city it is also authorised to carry on a general electric lighting business. The Manila Suburban Railways has a 47-year franchise from January, 1906, and its lines are a part of the system of the Manila Electric Railroad and Light Company, providing connecting links to the suburbs with the company's system. Manila, it is hardly necessary to say, is the social, political and business centre of the Philippines. It has a population of about 300,000, and transacts about 80 per cent. of the entire commerce of the Archipelago. The importance of a company which now controls the entire street railway lighting and power business of Manila, as the Manila Railroad and Lighting Corporation does, will thus be recognised. As regards earnings, statistics show that while profits fell off slightly in the first half of 1909, owing to a strike which was successfully overcome after lasting a considerable time, they recovered substantially in the corresponding period of the current year and amounted to $313,277, as against $242,046 in 1909, and $262,045 in 1908, and the company has increased its surplus from $342,492 as at December 31, 1907, to $433,874 as at December 31, 1909. According to all accounts, there is every reason to believe that this improvement will be maintained. The Corporation, it should be added, paid 3 per cent. on its common stock for 1906 and 1907, and 4 per cent. for each of its following years. During 1910 a distribution of 1 per cent. per quarter has been made. The price of the stock has risen within the past three months from $59.50 to $65 ex. dividend, and at the latter figure yields to the investor on the present dividend the sum of £6 3s. per cent.

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COMPANIES REGISTERED.

ELECTRIC POWER PLANTS, LTD.—Capital £15,000, in £1 shares (10,000 Preference). Objects; To carry on the business of manufacturers of and dealers in and contractors for electric power plants, turbines and apparatus, suppliers of electricity for light and power, etc., and to adopt an agreement with A. H. Gibbings and P. J. Mitchell. Minimum cash subscription, 33⅓% of the shares offered to the public. The first directors (to number not less than three nor more than five) are P. J. Mitchell, C. O. Bastian and A. H. Gibbings. Qualification, £20. Remuneration, £50 per annum. Registered office, Caxton House, Westminster.

MANCHESTER FILM SERVICE, LTD.—Capital, £1,000, in 950 Preference shares of £1 each and 1,000 Deferred shares of 1s. each. Objects: To carry on the business of manufacturers of, and dealers in, cinematograph pictures, lenders on hire of cinematograph films, etc. Private company. The first directors are H. V. Kilvert, E. Ridings, W. Hughes, J. Marks and E. W. Walker. Qualification, 50 shares. Registered office, 23, Fountain-street, Manchester.

NUNEATON ELECTRICAL CONTRACTING COMPANY (LTD.). Capital £1,000, in £1 shares. Objects: To carry on in Nuneaton or elsewhere the business of dealers in electrical fittings and appliances, electrical engineers, etc. The subscribers are: G. Cross, Newdegate-street, Nuneaton, and G. R. Clay, 12, Market-place, Nuneaton. Private company.

LIENS REGISTERED.

ELECTRICAL CONTRACTS AND MAINTENANCE COMPANY, LTD.—Issue on August 4 of £200 Debentures, part of a series of which particulars have already been filed.

EDUCATIONAL.

NORTHAMPTON INSTITUTE.

The winter session of the Northampton Polytechnic Institute, St. John-street, Clerkenwell, opens on Monday, October 3. The electrical engineering side has always been strong at this Institute. The department is under the Principal, Dr. R. Mullineux Walmsley, assisted by Mr. F. M. Denton as Associate Head and a powerful staff of professors, lecturers and demonstrators. Among the special lecturers are Dr. J. Erskine-Murray, Mr. H. M. Hobart, Mr. E. Kilburn Scott, Mr. A. C. Jolley, and others. The fees are moderate, and the course of instruction comprehensive, great advantage being derived from the splendidly equipped laboratories and workshops and the generating station, which has just been installed at a cost of £6,000.

FARADAY HOUSE.

The Electrical Standardising, Testing and Training Institution, Faraday House, have issued the syllabus of their training department. The Michaelmas term opens on September 26. The training at this institution provides students with a training in theoretical and practical electrical engineering, the commercial side not being neglected. The full course covers four years, the first year being spent at Faraday House, the second at engine manufacturers, the third at Faraday House, and the fourth at an electrical manufacturer or a power house. Thus the training combines both personal tuition and actual practice in all branches. The principal is Dr. Alexander Russell, and his staff includes Dr. W. Buchanan, Mr. J. N. Alty, Mr. W. R. Cooper, Dr. W. H. Eccles, Mr. H. M. Hobart, and Mr. J. Rennie.

UNIVERSITY COLLEGE, LONDON.

The Session in the Faculty of Engineering at University College begins on October 3. The Provost and the Dean will attend on Monday and Tuesday, October 3 and 4, from 10 a.m. to 1 p.m., for the purpose of interviewing students and advising them as to their courses. In addition to the regular Undergraduate Courses, the following Postgraduate Courses will be given during the coming term:—Steam Turbines (supplementary to Course in Session 1909-10), by Mr. E. G. Izod, of Messrs. Willans & Robinson, on Fridays, at 5.30, beginning October 21; Railway Engineering, by H. Deans, M.A. (Cantab.), M.Inst.C.E., of the Great Western Railway, on Mondays and Thursdays, at 5, beginning October 6; Photographic Surveying, by M. T. Ormsby, M.Inst.C.E.I., on Fridays, at 4, beginning October 14; Electrical Design, by H. M. Hobart, B.Sc., M.Inst.C.E., M.Inst.E.E., on Mondays, from 5 to 7, beginning October 10.

EVENING EDUCATION IN LONDON.

The London County Council Evening Schools, Technical Institutes and Schools of Art re-opened on Monday, the 19th instant. The evening classes at the polytechnics will re-open on the 26th. During the winter session, 1909–10, some 170,000 boys and girls, young men and women enrolled themselves as students at evening classes of all kinds, and a large proportion maintained a regular attendance throughout the session. The steady growth of a large body of serious students and the general sympathy and active encouragement of employers show that evening education is much appreciated, and forms a valuable part of our educational organisation.

In the schools, as a whole, instruction is provided for every kind of student, young or old, employer or employee. The fees charged at ordinary evening schools are well within the reach of most young wage-earners, and vary from 1s. to 5s. for the whole session. In many cases no charge is made for apprentices or improvers. At the polytechnics, technical institutes and schools of art the fees are, as a rule, a little higher.

Not only do the evening schools provide plenty of mental work, but a great deal of attention is also devoted to drill gymnastics and physical education generally. Further, there are many social advantages to be shared by those who are attending more advanced evening instructions—clubs, various societies and athletic meetings. Such advantages do not form the main object of the evening schools. They are only to be shared by those who have put the question of hard work and instruction in the foremost place.

Full details are given in the prospectuses of the various institutions. Any polytechnic, technical institute or council's evening school will supply handbills and prospectuses giving details of all the different kinds of instruction provided.

FINANCIAL NOTES.

NORTH BRITISH RAILWAY.—The directors, after declaring the full dividend on the Preferred Ordinary stock, recommend a distribution at the rate of ½% per annum on the Deferred stock, carrying forward £28,000. A year ago the Deferred stock received no dividend, and £22,000 was carried forward.

* * *

PUEBLA TRAMWAY, LIGHT AND POWER.—The results for the year 1909 showed a net profit in Mexico of £48,677, as against £27,354 for 1908. For the six months ended June 30 last the net earnings in Mexico were approximately £26,000, and the bond interest is therefore more than covered. The development of the Tuxpango Falls has not yet been commenced, but it cannot be longer delayed. The growing demands of the City of Puebla, the absorption of the power the company has at present available, and the terms of the company's concession from the City of Puebla make it essential that 15,000 h.p. should be available for sale within the city boundaries by 1913.

* * *

SAO PAULO TRAMWAY, LIGHT AND POWER.—The British Empire Trust Company, Ltd., notify that the Sao Paulo Tramway Light and Power Company, Ltd., have declared a quarterly dividend of 2% on the capital stock, payable on October 1 to all shareholders on the register on the 21st inst. The London registers will be closed against transfers from the 21st to the 30th inst., inclusive, for the preparation of dividend warrants.

* * *

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER.—The debenture stock register and register of transfers will be closed from the 17th to the 30th September, 1910 (both days inclusive), for preparation of warrants for interest on the Company's 4½% First Mortgage Debenture Stock, payable October 1, 1910, for the half-year ended that date.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

COUNTY BOROUGH OF STOKE-ON-TRENT.

ELECTRICAL ENGINEER'S DEPARTMENT.

APPLICATIONS are invited for the position of RESIDENT ENGINEER for one of the works under the control of the Council. Applicants must have had thorough mechanical training, experience in a three-wire D.C. station, and be capable in the management of men.

Salary £180 per annum.

Forms of application and particulars of duties obtainable from the Chief Electrical Engineer.

Applications to be sent to the undersigned not later than the 26th inst.

E. B. SHARPLEY,
Town Clerk.

Stoke-on-Trent.
September 13, 1910.

COUNTY BOROUGH OF DERBY.

ELECTRICITY DEPARTMENT.

TENDERS are required for Steel and Cast Iron PIPING.

Forms of tender and full particulars on application to the Borough Electrical Engineer, Full-street, Derby.

CITY OF SHEFFIELD.

ELECTRIC SUPPLY DEPARTMENT.

Contract No. 66.—Steam Turbine, Alternator, Exciter, Condensing Plant, Pumps, and other Accessories.

Contract No. 67.—Three Water-Tube Boilers, Economisers, Induced Draught Fan, Steel Chimney, etc.

The Electric Light Committee of the City of Sheffield are prepared to receive tenders for the above plant.

Specifications, forms of tender, and general conditions of contract, can be obtained from the undersigned on payment of the sum of one guinea for each contract, which will be returned on receipt of a *bona-fide* tender if accompanied by the complete specifications and general conditions. Additional copies of the specifications, form of tender, and general conditions of contract may be obtained on payment of 10s. 6d. per set, or part of a set for each contract, which sum will not be returned.

Any person or firm sending in a tender will be required to add a schedule to such tender stating the names of the various classes of labour which he or they intend to employ, together with the place where such labour will be employed and the rates of wages, hours of labour, and conditions of employment to be paid and observed in respect of each class of labour, all of which as shown in such schedule, shall comply with the City Council's form of clauses respecting wages, hours, conditions of labour, and prohibition against assigning or sub-letting.

Tenders, sealed and endorsed, "Tender for Contract 66 or 67," to be delivered at these offices not later than 10 o'clock a.m. on Friday, September 30, 1910. The Committee do not bind themselves to accept the lowest or any tender.

S. E. FEDDEN,
General Manager and Engineer.

Corporation Electric Supply Department,
Commercial Street, Sheffield.

CONTRACTS OPEN.

HOME.

BIRMINGHAM.—The Electric Supply Department invite tenders for the supply of 78,000 tons of coal, for delivery between October, 1910, and October, 1911. Particulars from the City Electrical Engineer. September 30.

DERBY.—The Borough Electricity Department invite tenders for steel and cast iron piping. Particulars from the Electrical Engineer.

DEVONPORT.—The Electricity Department invite tenders for twelvemonth's contract supply of coal. Particulars from the Electrical Engineer. September 29.

EDINBURGH.—The Corporation invite tenders for the supply of (Specification No. 59) Steam turbines, D.C. generators, and condensing plant; and (Specification No. 60) interior parts of cooling towers. Particulars from the City Electrical Engineer. October 10.

LONDON.—The Secretary of State for India invites tenders for the supply of engines and generators. Particulars from Director-General of Stores, India Office, Whitehall, S.W. October 4.

LONDON.—London County Council invite tenders for the road-work and platelaying required for the re-construction on the conduit system of the Council's tramways in Highgate-road, and for the paving works of certain street widenings in connection therewith. The route is equivalent to about 1½ miles of single track. The contractor will be required to use the track rails with their fastenings, the slot rails, the conductor rails, and the special work for the turnouts, etc., which will be provided by the Council under other contracts, but all the remaining metal work and other materials will be included in the contract. Particulars from the Chief Engineer, County-hall, Spring-gardens, S.W., upon payment to the cashier of the Council of £5. October 11.

LONDON, FOR DURBAN.—The Town Council of Durban invite tenders for the supply of elevated jet condenser and piping, switchboard, rotary converters, cables and transformers. Particulars from Messrs. Webster, Steel & Company, 5, East India-avenue, E.C., to whom tenders must be sent by September 28.

RHYL.—The Urban Council invite tenders for a year's supply of fuel oil from October 1 next. Particulars from the Electrical Engineer. September 28.

SHEFFIELD.—The electric supply department invite tenders for supply as under: Contract No. 66, steam turbine, alternator, exciter, condensing plant, pumps and accessories; Contract No. 67, three water-tube boilers, economisers, induced draught fan steel chimney, etc. Particulars from the Electrical Engineer. September 30.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage électrique à Béni-Souef—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministère de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels. September 26.

MELBOURNE.—The Deputy Postmaster-General invites tenders for: (2) Up to 3 p.m. on October 18, for the supply of 23 miles of telephone cable (Schedule No. 284); (3) Up to 3 p.m. on October 18, for the supply of 500 composition insulators (Schedule No. 374); (4) Up to 3 p.m. on October 25, for the supply of 10,000 Cordeau insulators (Schedule No. 373). A deposit will be required with each tender. Local representation is necessary.

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Telegrams: "Bulbolite, London."

Head Office and Works:
BRIMSDOWN, M'SEX.

Imperial Lamp Works (Brimsdown) Ltd.,
SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). Specification, Direction des Chemins de Fer d'Outre-mer, Lisbon. October 12.

PARIS.—The "Moniteur Officiel du Commerce" (Paris) contains a notice inviting tenders for the supply and laying of a submarine cable between Libreville and Loango (Pointe Noire). To qualify tenders, a provisional deposit of 50,000 francs (£2,000) will be required, to be increased by the successful tenderer to 100,000 francs (£4,000). Tenders will be received up to October 14 at the "Bureau de l'Ingenieur Chef des Etudes, Ministere des Colonies, rue Oudinot No. 27," Paris.

SHANGHAI.—Tenders are invited by the Shanghai Electricity Department for the supply of the following: (1) Electric heating and cooking appliances; (2) 10,700 carbon filament lamps; (3) 15,000 metallic filament lamps. Sealed tenders, marked "Tender for Heating and Cooking Appliances," or as the case may be, should be addressed to the Acting Secretary, Council Rooms, Shanghai. Date: (1) October 10; (2) and (3), October 20.

TENDERS ACCEPTED.

HOME.

BRISTOL.—The following tenders have been accepted: (1) The City Glass Company, dated May 6, for the supply of arc lamp globes, 1910–1911 contract, for the sum of £38 15s.; (2) Messrs. Siemen Brothers Dynamo Works, Ltd., dated June 17, for the supply of three-phase, extra high tension, low tension, and direct-current switchgear at the Docks Sub-station, Underfall-yard, for the sum of £204 15s.; (3) Messrs. the British Westinghouse Electric and Manufacturing Company, Ltd., dated June 30, for the supply of two three-phase 3,000 kw. steam turbo alternators for the sum of £25,290. (This is in substitution for one single-phase and one three-phase alternators agreed to be supplied for the sum of £23,443, under two contracts dated July 21 and November 30, 1906, respectively); (4) Messrs. Slaughter & Bray, dated July 11, for constructional work, etc., at the Exchange, in connection with the offices, showrooms, and stores scheme, for the sum of £1,372.

CARLISLE.—The Town Council have accepted the tender of Messrs. Prachitt Bros., of Carlisle, for the supply and fixing of a coal conveyor and bunker at the Electricity Works, at a cost of £860.

LONDON.—London County Council. Tenders for wiring for electric lighting of the Central Car Repair Depot (second section): The Central Motor Engineering Company, Holloway, N., £1,571 8s. 3d.; E. Lawrence & Sons, Ltd., Wharf-road, N (accepted), £1,702 17s. 3d.; G. E. Taylor & Company, Bush-lane, E.C., £1,863 19s 6d.; Johnson & Phillips, Ltd., Old Charlton, £1,877 3s.; Tilley Bros., Kingsland-road, N.E., £1,888 12s. 6d.; E. Newbald & Company, Sutton, £2,024 8s. 5d.; Pinching & Walton, Cannon-street, E.C., £2,035 10s.; G. Weston & Sons, Ltd., Fenchurch-street, E.C., £2,043 12s. 9d.; Gordon Lawson, Eltham Park, £2,320 2s. 6d.; Barlow Bros. & Company, Shaftesbury-avenue, W.C., £2,425 16s. 4d.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

AIRDRIE: There is a proposal to build a Town Hall at a cost of £10,000.

BIRMINGHAM: City Engineer. Workshops and Offices for Lighting Depôt.

DUBLIN: City Treasurer. Fire Brigade Station.

HULL: J. Young & Company, architects, 62, Market-street, Bradford. Electric Theatre for the National Electric Theatres (Ltd.).

NOTES.

"Sun" Screwed Tube System.

The Sun Electrical Company, Ltd., are doing very well with their "Kalkos" system of wiring, in which tinned brass tubes, with special adjustable boxes and safety switches are used. Many electrical contractors, however, find it necessary to adopt the older screwed steel tube system in order to comply with specifications, prices and so on. To meet these needs the Company are now placing on the market the "Sun" steel-screwed tube system, in which the "Kalkos" iron boxes and "Kalkos" switches are retained. It will be remembered that the "Kalkos" box is of the double compartment type, giving a clear space between the bases of the switches, plugs, ceiling roses, and so on, with the result that the bottom of the boxes can be used as distribution or joint boxes, and placing all

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joints so that they become accessible merely by unscrewing the box cap. This simplifies both installation and maintenance. Moreover, the peculiar feature of the "Kalkos," the adjustment ring, enables the box to be made flush with the plaster, as the ring can be screwed to left or right until perfect adjustment is attained. The system also allows of further adjustment at the switch plate, as this is slipped over the projecting male thread of the box cover and automatically adjusts itself to the plaster or panel, irrespective of the angle at which the box is fixed. The whole system is easy to understand and to instal. A full range of accessories, wall sockets, ceiling roses, bracket bases, extension pieces and switches have been designed for the system. The "Kalkos" switch, by the way, is very compact and unobstrusive, with all live parts well encased in porcelain.

Insulators and Water-tight Fittings.

Mr. G. Braulik is issuing a revised illustrated price list of porcelain insulators. There are a large and varied assortment of these for telegraph, telephone and power purposes. These include the patent two-part terminal insulator bobbins for loose wires and cable fixing, and the patent double mantle insulator bobbins for tensions up to 1,500 volts, and for use in accumulator rooms, mines and damp places. Other insulator accessories comprise porcelain cleats, "Gnom" flexible connectors (one-way, two-way and three-way), and sectional leading-in conductors. With the rapidly spreading industrial uses of electricity this price list becomes valuable and should be kept on file. Another of his publications relates to high-class light cast-iron water-tight fittings for lamps. These include ships' fittings, hand lamps and a fine selection of cluster light fittings for high candle power lamps.

"Sarco."

Messrs. Sanders, Rehders & Company, Ltd., are issuing a little "bulletin of power plant practice," which they call "Sarco." While somewhat in the nature of a house-organ, it is not obstrusively so, and gives much useful information. For instance, among the contents of the August issue we note articles on "Detection of air leaks in Boiler Settings," "Use of Draft Gauge," "Use of Recording Instruments," and "Combustion of Coal." This last-named article, which is packed with facts, is continued in the October issue, which also contains some very pertinent "Don'ts for C O_2 Recorder Users."

Bead Shades.

Some quite new patterns of bead shades for electric lights are being brought out by Messrs. Taylor & Company. They are pretty in design, effective as regards colouring and quite useful for their purposes. These are worth the attention of contractors now that the lighting season is fast coming on.

Electric Cooking.

The British Prometheus Company, Ltd., are about to issue an exceedingly artistic, beautifully printed circular intended for circulation by electric contractors among their private customers. It gives excellent illustrations and telling descriptions of all kinds of cooking appliances, from the kettle or egg boiler to the handsome tea urn and handy stove, with brief descriptions suitable for the consumer of current. No prices are quoted, but a blank space is left for the name and address of the dealer to be printed. Readers should at once apply to the Prometheus people for a supply of hese, which should prove money-getters.

RUBBER CABLES.

Messrs. Pooley & Austin, electrical and mechanica engineers, of 25, Victoria-street, Westminster, as Messrs Frankenburg & Sons (of Manchester) sole London agents are now holding a stock of the usual sizes of rubber cables, in order to give prompt delivery to their customers in this district.

PALLADIUM THEATRE OF VARIETIES.

Referring to the notice in our "Tenders Accepted" column in which it was stated that the contract for the complete electrical equipment of the Palladium Theatre of Varieties had been secured by Messrs. Siemens Brothers Dynamo Works, Ltd., it may be of interest to state that the establishment will be lighted throughout by Siemens fittings and "Tantalum" lamps, and the circuits protected by "Zed" fuses. "Stannos" wires have been specified for the wiring, which, as stated before, has been sublet to Messrs. Rashleigh Phipps & Company, whilst it is intended that the theatre shall be equipped with the most up-to-date and efficient system of illumination and lighting effects.

ELECTRIC LIGHTING FURTHER POWERS BILL.

The following towns have signified their intention of giving support to the Bill to be presented by the Incorporated Municipal Electrical Association:—Ayr, Wakefield and Manchester will give financial support; Northampton, Chester, Shrewsbury, Radcliffe, Burnley, Leytonstone will give moral support; Sunderland merely expresses its approval; Bexley Heath will consider the matter again. St. Annes on-Sea, however, will take no action.

Shawinigan Water and Power Company.—The President of the Shawinigan Water and Power Company announces that as from the commencement of next year the dividend will be raised to 5 per cent., as against 4 per cent. paid hitherto. It is also proposed to issue $500,000 new shares at par to the existing proprietors. The "Financial Times" adds that the latest reports concerning the progress of business are very encouraging and with the expansion anticipated in the scope of the company's operations during the next few years an increased degree of prosperity is looked for. The feature of the company's working is the extremely low ratio of its operating charges resulting from the circumstance that its plant is situated in the centre of the district to which it supplies electrical energy, while the fact that the power is sold in bulk instead of in retail quantities also leads to economies in working. Most of the hydro-electric power companies have had to lay and maintain several hundred miles of distributing mains, the cost of which is not only heavy in the first place, but is considerable at all times in respect of maintenance charges.

Mr. W. Vincent Waite, late Works Manager to Messrs. Bruce Peebles & Company, Ltd., was the guest at a complimentary dinner given in Edinburgh on the 14th inst., on the occasion of his leaving the firm to start business on his own account in Cardiff. Earlier in the day Mr. Waite was presented with a handsome sideboard, and Mrs. Waite with a silver salver as a token of appreciation from the workmen and staff. The presentation was made in the Main Shop, by Mr. Lee Murray, the general manager of the company, and Mr. Waite feelingly replied. Mr. W. A. Scott, formerly assistant works manager, has been appointed to fill the vacancy created by Mr. Waite leaving the firm.

PATENTS.

Electrical Devices for Controlling Movements from a Distance.

18847.—1909. P. Viry, Suresnes, France. This is a modification of a device described in specification 18624.—1909 (see The Electrical Engineer, August 19, page 219) for controlling a number of movements from a distance. The emission of continuous current producing the disengaging is obtained merely by releasing the controlling buttons, each of which is provided with a stop or tappet, which in the return movement of the button makes a continuous contact and brakes it at the end of a stroke.

Telegraph Bulletin Printers.

23324.—1909. Electric Press Bulletin Company, Williamsport, U.S.A. The printer comprises a type shaft upon which is a type wheel that normally tends to rotate and which is controlled by selector devices. A cushioning device co-operates with the type wheel, which cushions its impact and facilitates stopping.

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Transmitting Apparatus for Wireless Telegraphy.

20229.—1909. G. MARCONI, London, W.C. It has been proposed to employ a transmitter in which the gap between two terminals of the oscillation circuit is more or less bridged at intervals by means of bridging pieces in very rapid movement. These bridging pieces consist of studs fixed to a rapidly revolving disc. In order to increase the utility of the transmitter an auxiliary condenser is inserted across the terminals of the generator and parallel with the first condenser. The auxiliary condenser is of large capacity and acts as a reservoir from which the first condenser can be fully charged through inductive resistances of suitable value in the very short time available.

Electrical Switches and Switch Fuses.

21185.—1909. H. H. BERRY, AND W. J. MARKHAM, London, E.C. This is an improvement in switches and switch fuses of the armoured type and in which the cover of the case is hinged at one side or at the end. Recessed bars are provided for receiving and clamping the contacts. Insulating material is inserted between the contacts and the bars.

Audible Electric Signal.

23802.—1909. T. S. ROGERS, Saltley. A mica diaphragm having an anvil fixed in the centre is rolled into the dome shaped cover of a round box. The box and cover are both flanged. In the centre of the dome is a hole to emit the sound. A U-shaped frame is screwed into the bottom of the box. An inverted magnet is fixed on to the extremities of the frame and forms a bridge. At the poles of the magnet is a spring armature. On the side of the armature exposed to the poles of the magnet is a hammer. Directly a current is applied to the terminals a vibration is set up in the armature and hammer and a loud musical note is emitted from the hole in the cover as the result of the rapid successive strokes of the hammer on the anvil.

Mounting Incandescent Electric Lamps.

24950.—1909. A. W. BEUTTELL, Streatham. The appliance comprises a conductor channel of any suitable shape in cross section, open along one side and adapted to receive the conductor wires and lampholders. A reflector is fixed over the opening and covers the opening between the lamp holders and conceals the wires.

Electrically Reproducing a Movement at a Distance.

28164.—1909. HARLET & COMPANY, Paris. A Wheatstone bridge arrangement is employed in combination with contact making mechanism and a power motor adapted to be driven when the contact mechanism is operated. A number of controlling means and a number of controlled members may be employed.

Electrically Operated Ammunition Hoists.

29132.—1909. OTIS ELEVATOR COMPANY, Yonkers, U.S.A. This is an improvement in hoists of the type in which the ammunition is raised by a carrier to a position opposite the breach of the gun, and the carrier is held in its raised position by means of a reduced current supplied to the hoisting motor. The invention provides means whereby when the controller of the gun elevating motor is actuated to cause the breach end of the gun to be lowered, the holding current of the ammunition hoisting motor is automatically reduced by the introduction of resistance into the hoisting motor.

Checking Electric Glow Lamps.

2432.—1910. FELTEN & GUILLEAUME-LAHMEYERWERKE, A. G., Frankfort. The object is to provide means for ascertaining the amount of current which has passed through a lamp. For this purpose a strip of paper sensitive to light or a substance liquefied by the action of heat generated and liberated by the electric current is concealed in the lamp. The appearance of the paper or liquefiable substance shows the amount of current that has passed through.

Prepayment Electricity Meters.

3250.—1910. W. S. SPRAGUE & CHAMBERLAIN & HOOKHAM, LTD., Birmingham. The prepayment mechanism comprises a toothed wheel rack actuated by a spring or weight and a governing device such as a clock escapement. Some portion of the escapement has a loose pallet capable of giving way to allow of backward movement when winding. When consumption of the last coin inserted has commenced the switch is momentarily broken and restored as a warning to insert fresh coins.

Protective Devices for Electrical Systems.

6668.—1910. BRITISH THOMSON-HOUSTON COMPANY, LTD., London. These protective devices for alternating current electrical transmission and distribution systems are operative on leakage current and are arranged in various parts of the system. The arrangement is such that those devices which control parts remote from the source of supply will operate before those nearer such source.

Ventilation of Continuous Current Dynamo Electric Machines.

8409.—1910. SIEMENS BROS., LTD., AND W. PARKER, Westminster. In this machine an arrangement of stationary baffle plates causes air to impinge upon the field coils and to pass axially through the spaces between adjacent field coils in combination with a fan forming part of the armature. The diameter of the fan is less than that of the armature.

Protecting Vessels from Electric Currents.

9094.—1910. G. POLLITZ, Kattowitz. The separate parts of the vessels are conductively connected by means of washers inserted at the contact points. The washers have inwardly projecting points which come into intimate contact with the liquid inside the vessels and collect and conduct the electricity from the liquid to the outside of the vessel.

Electric Conduit Threaders.

10705.—1910. G. A. BROWN, E. G. GALENBY, D.R., AND A. H. GOURLAY, Toronto. The object is to provide means for enabling a cord to be instantaneously threaded through the conduit so as to enable the fish wire and finally the electric wire cables to be drawn through the conduit. The device consists of a casing to which a reel provided with a crank handle is journalled. A tube is attached to the outside of the casing and is provided with a valve and coupling at the lower end by means of which an air hose is attached. The upper end of the tube has a nozzle. A hollow plug surrounds the nozzle and closes the end of the conduit wherein the dart is placed in order to thread the conduit.

Telephone Exchange Circuits.

11251.—1910. SIEMENS & HALSKE, A. G., Berlin. This is an improvement in exchanges in which automatic selector switches are used for connecting a calling line with a service station. The improved switch has a separate set of leads and contacts provided for each selector in addition to the usual leads and contacts. The leads connected with those separate contacts are connected to only one calling line. The contacts and their leads are only found by the selector arm when the leads of all other contacts are engaged. Calls are thus received immediately under all conditions and can generally be quickly dealt with.

Preventing Remanent Magnetism in Dynamo Electric Machines.

14153.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. A low reluctance magnetic path is provided for the remanent magnetism in parallel with the path by way of the armature core in such a manner that practically all the remanent magnetic field will take the specially provided path instead of the armature path where it of course cuts the armature conductors and produces a voltage. The low reluctance path takes the form of magnetic bridging pieces of iron. They are of about one or two millimetres thick and although their reluctance is practically *nil* for the small remanent flux it is very great when the dynamo is fully excited.

Breaking Action in a Polyphase Commutator Electric Motor.

14353.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin The whole or part of the stator winding and the armature winding are so arranged that the machine acts as a self-exciting direct-current generator. The output of the generator is controlled by moving the brushes around the commutator, and thus graduating the brake action.

High Tension Magneto-Electric Machines.

15380.—1909. F. R. SIMMS AND THE SIMMS MANUFACTURING COMPANY, Willesden Green, N.W. This is an improvement in magneto-electric machines used in connection with magneto-electric gear for internal combustion engines, and in which the condenser is arranged in the armature coil. In order that the condenser may be firmly held in position the armature cheeks are extended and the condenser is held in between them. The extensions and the condenser are enclosed in a ring. A packing surrounds the condenser.

Switch Gear for the Remote Control of Electric Motors.

18675.—1909. M. T. MEDWAY AND M. D. SCOTT, New Cross, S.E. The object is to render it possible to reverse the armature current of the motor until the motor has come to rest. For this purpose the current produced by the motor when rotating by momentum, and acting as a dynamo after the main circuit has been broken, is employed to hold open a switch controlling the armature circuit.

Electric Battery Lamps.

18756.—1909. F. J. AND W. A. TURQUAND, London, E.C. The lamp bulb and adjacent fittings are carried on top of its cover plate. A protective cage may be added which will serve as a base for the lamp to stand on when inverted. A dome fits over the cover plate and encloses the lamp. The lamp is put in and cut out of circuit by rotating the dome, which movement causes a switch to make and break contact. As the switches are enclosed in a perfectly gas-tight enclosure all risk of sparking in a combustible atmosphere is prevented.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Miles of track open.		Accounts for past year.						Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Sept. 14	1,458	1,393	+ 65	— 178	27½	27½	May 31	71,939	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Sept. 11	1,126	1,059	+ 67	+ 686	24·089	24·089	—	—	—	—	—	—	—	—
Birmingham Corporation	Sept. 10	6,688	6,434	+ 254	+ 1,918	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Sept. 10	5,315	4,896	+ 419	+ 4,033	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Sept. 18	1,136	1,113	+ 23	+ 49	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Sept. 16	6,230	5,771	+ 459	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Sept. 17	1,387	1,337	+ 50	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Sept. 11	275	266	+ 9	— 2	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Sept. 17	5,393	5,039	+ 354	+ 3,399	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	[5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Sept. 18	3,091	3,013	+ 78	+ 236	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Sept. 15	534	503	+ 31	+ 1,748	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Sept. 2	1,657	1,714	— 57	+ 3,325	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Sept. 16	159	154	+ 5	+ 115	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Sept. 16	5,503	5,267	+ 236	+ 1,486	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Sept. 17	1,078	1,002	+ 76	+ 704	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Sept. 10	18,626	17,503	+ 1,123	+ 13,373	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Sept 17	2,565	2,587	— 21	+ 3,415	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Sept. 7	133	136	— 3	— 188	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Sept. 14	1,398	1,325	+ 73	— 497	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Sept. 11	1,498	1,419	+ 79	+ 137	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Sept. 7	41,443	36,832	+ 4,611	+ 126503	135½	124	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Sept. 17	10,215	9,647	+ 568	+ 6,891	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Sept. 18	16,710	16,207	+ 503	+ 5,955	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Sept. 10	3,716	3,749	— 33	+ 1,040	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Sept. 11	5,909	5,499	+ 409	+ 8,580	40	39¾	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Sept. 7	1,233	1,149	+ 83	+ 570	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 10	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Sept. 10	1,068	971	+ 96	+ 200	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	— 97	+ 1,985	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *b* Half-years' figures.

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NOTES.

Car Meters.

At the Conference of the Municipal Tramway Association, questions of economy were largely to the fore, but little was said directly as regards the use of meters to attain this end. Yet Bradford, through the worthy President of the Conference, was the first city in England to try the use of meters on cars on a large scale, and benefit thereby. If our Conference was practically silent on this subject, it was otherwise with the International Tramways Congress just held at Brussels. There two important reports were presented, Herr Battes, general manager of the Frankfort-on-Main Corporation Tramways, dealing with "Practical Results Obtained with Car Meters," and Monsieur Bouton, general manager of the East Paris Tramways Company, reporting on the same subject from French experience. The question first cropped up at the Milan Congress in 1906, when Mr. Wattman drew attention to its importance, and Herr Battes and Herr Otto, chief engineer of the Berlin Tramways, were appointed as reporters on the question to be discussed at Munich two years later.

The First Reports.

Herr Otto found that economy was undoubtedly secured, but that further investigations ought to be made. As regards current consumption, he found that the readings of the hour meter and of the watt-hour meter were equally accurate, that the cost, maintenance and working expenses of the hour meter were considerably lower than those of the watt-hour meter, and that the reliability of the hour meter was greater than that of the watt-hour meter; he, therefore, recommended the adoption of hour meters. In the introduction to his report he stated that any method of checking, if properly carried out, resulted in considerable savings, both in current consumption and in the life of the various parts; he showed that both types aimed at the same result, but that the former was far simpler and generally preferable. Herr Battes' report ended with the following recommendations:—

1. In small undertakings, careful personal supervision of the lines makes the adoption of car meters unnecessary.
2. In all larger undertakings, checking current consumption by means of meters placed on the cars is advisable.
3. This checking becomes increasingly necessary in proportion to the difficulties of the service; under ordinary service conditions in large towns the driver's attention is being constantly taken up, and failing meters, his driving would remain quite uncontrolled, and would result in a very high rate of current consumption.
4. The different systems of checking are by watt-hour meter, ampere-hour meter, and hour meter.
5. As this checking is not intended solely for the purpose of recording the exact amount of current consumed, the hour meter will be sufficient on account of its reliability, simplicity and cheapness.
6. The clerical work entailed is of a simple nature, and should not prove costly; various methods of doing this are already in use.
7. A system of bonuses where savings are effected, is not generally recommended.

In conclusion, he pointed out that a suitable system of checking should result in a diminution of accidents, and he appealed to the various undertakings to especially consider this feature when preparing their reports.

Herr Battes' Second Report.

In order to give effect to this last expression of opinion, Herr Battes drew up a list of questions, in conjunction with Monsieur Bouton, and sent it broadcast among tramway managers. As the result of numerous replies, it appears abundantly clear that the use of meters has brought about very considerable savings, and their use is rapidly extending. At first the watt-hour meter was favoured, but during the past year (1909–10) the hour-meter is making far more rapid progress. On the whole, the use of meters has given very little trouble, although some managers complain that drivers are apt to start too suddenly. Since the general use of meters, fewer accidents have occurred. The ampere-hour-meter is but comparatively little used on the Continent. It is, however, giving much satisfaction at Bordeaux, where they have resulted in a saving of 10% of the current, while at Marseilles they show greater reliability than the hour meters. This is a triumph for British electrical engineering, for the ampere hour-meter of the motor-mercury type was introduced by Ferranti, and has also been developed along special lines in the Chamberlain and Hookham meter. It is the ampere hour-meter that finds by far the most favour among the 60 or so insular tramway authorities who have adopted or are experimenting with meters. As regards Herr Battes' report, he says that "in the matter of possible improvements in the various types of meters now on the market, we call attention to a wish expressed by several of our members to the effect that car meters should be designed with a view to separately registering the current consumption and the current duration for series and parallel running. Other undertakers suggest automatic instruments, in order to prevent unduly rapid starting by drivers. Whatever justification there may be for these requests, the fact remains that the introduction of car meters should certainly not be delayed."

Monsieur Bouton's Report.

M. Bouton points out that it is no longer a question of the advisability of using meters, it is resolving itself into the problem of the best type to use. His final conclusions are as follows:—

1. Generally speaking, it is advisable to check the driver's energy consumption by means of car meters; to make this really effective each car should be provided with a meter.
2. We suggest two methods for carrying out this policy:
   (a) In order to insure that each driver shall utilise the smallest possible amount of current compatible with service requirements, the individual goodwill of the men may be stimulated by instituting a system of extra remuneration or penalties, as the case may be, according to ascertained results; these results can be classified by printing periodical lists of the men in order of merit, calculated on the closest possible readings of the amount of energy consumed by each, and considered in relation to a fixed standard previously certified to be fair for the work contemplated. For this purpose watt-hour and ampere-hour meters are best.
   (b) A uniform standard of driving may be prescribed, approximating as closely as possible to a set precedent for each separate route. Whilst no attempt would be made to classify drivers according to the amount of energy they consumed individually, the object would rather be to call attention to those who failed to comply with the required standard. For this

purpose hour meters are best; their readings are sufficiently full, if supplemented by careful supervision, and this would have to be all the closer from the fact that the men would probably be less conscientious and more liable to resort to prohibited methods for obtaining the requisite satisfactory results.

3. The use of watt-hour or ampere-hour meters is recommended under any of the following conditions: Where there is a feeling amongst the men in favour of a bonus system; when careful supervision of drivers is made difficult from local circumstances; when, owing to dense traffic and crowded thoroughfares, stops are frequent; when there are numerous curves or steep gradients; with heavy cars; with motors of limited capacity; when the price of current is high, etc., in short, under all circumstance in which the driver's action has a direct influence on the running costs.

The use of hour meters is recommended in cases where the above conditions do not exist.

It should be left to the manager to decide in any other cases, and he would have to carefully weigh the advantages and disadvantages of the various meters in relation to his system. Finally, in exceptional cases, such as follow, we think it may be said that car meters are unnecessary: Where the system is only a small one; supervision of drivers easy and effective; price of current low; current consumption moderate; comparatively few stopping-places; light cars, level lines, etc.

4. Car meters of either type are now on the market which will meet any of the above requirements.

Electro-Metallurgists.

Sheffield manufacturers interested in the application of electricity to metallurgy, including platers and gilders, have formed a local Electro-Metallurgical Society, which should have a prosperous carreer and assist in the development of a most important branch of industry. The office bearers show that in this society there is just the right blending of science and industry. For instance, the president is Professor Arnold; vice-presidents, Professor McWilliam, Dr. Hutton (of Messrs. William Hutton & Sons), and Mr. T. Scott Anderson; chairman of committee, Mr. Arthur Parsons; hon. secretaries, Mr. G. Bernard Brook and Mr. Frank Mason; committee, Messrs. W. R. Barclay, A. Barker, W. G. Turner, Charles Puttrell, A. Jefferson, A. Benton, Byron Carr, and R. W. Girdwood.

Too Much Advertising.

It is somewhat quaint in these days to read that at the Grimsby Town Council a certain Alderman Pickwell questioned the benefit of so much advertising of the electricity department, there being an item on the agenda to publish posters on Corporation property. He said there was no one who had an idea of how much money had been spent in advertising the electricity department, and it was just a question whether the returns justified the expense of the issue of posters on every available piece of Corporation frontage. He moved that the scheme be not proceeded with, and that the advertising be done through the usual channels. Actually someone was found to second the proposal. When Councillor Collins suggested it would be a good scheme to have central premises to give demonstrations as to what electrical appliances could accomplish, the engineer said it was a very costly scheme, though some cities had carried it out with success. He drew attention to the fact that the advertising already done during the past year produced good results; more than twice as many customers had been connected during the past five months than in the corresponding period of either of the previous two years. Ultimately, it was resolved to continue the advertising scheme, and that the posters be printed in colours by contract.

Tramcar Ventilation.

While on the subject of tramways, it may be well to allude to the very savage growl of the "British Medical Journal" concerning the system of ventilation in connection with the London County Council tramcars. Our contemporary says:—

"Unfortunately, the cars introduced not very long ago are so built that instead of promoting the health of Londoners, they must have the opposite effect. So far as the inside seats are concerned, there is little room for criticism, but the arrangements made for what are ironically called 'outside seats' are simply foolish. The chamber in which 'outside' passengers have to sit is either stuffier than a tenement dwelling or one in comparison with which the Cave of the Whirling Winds must have been a place of breathless calm. On a wet day the ventilation is not sufficient for cigarette smoke to escape, and on a fine day the draughts are of so searching a nature that the London County Council, through its Tramway Department, must already have been the cause of many deaths and more illnesses among its ratepayers and those of surrounding boroughs. There is no evidence of lack of physique on the part of the victims, for while fresh air is good for every one, draughts are exceedingly dangerous, even to those possessed of the strongest constitutions." As our readers are no doubt aware, for inside ventilation there is the Cowper-Coles automatic system, which answers excellently.

Electric Lighting Further Powers Bill.

The Incorporated Municipal Electrical Association have received the following replies to their circular:—Blackburn: Will consider the matter further when Bill is drafted; Hounslow: Will give moral support, and re-consider financial point when Bill is drafted; Manchester: Will give moral support, financial point is deferred for the present.

India and Electricity.

In our last issue we made a brief announcement that the Tata Bombay electric scheme had been carried through. Further details are now to hand. A local company has been registered with a capital of 170 lakhs of rupees (close upon £1,250,000), and of this sum local merchants and native princes have guaranteed more than a million sterling. It is, as already explained, an immense hydro-electric scheme, designed to supply current for motive power in factories, for lighting and for traction. One of the results, it is anticipated, will be the early electrification of the Bombay, Baroda and Central India Railway from Colaba to Virar, and of the Ghat sections of the Great Indian Peninsula. All this, of course, emphasises what we have so often insisted upon, the vast opening for British electrical machinery and appliances in the Indian Empire.

PERSONAL.

Mr. A. Fraser, of Melbourne, has been selected from a number of applicants to fill the position of engineer for the Korumburra municipal electric light works.

Mr. Alan Eastwood, late in charge of the Yorkshire Electric Power Company's station at Pudsey, has been appointed to a similar position under the Lancashire Electric Power Company.

Mr. Walter T. Mills is over here just now on a mission from the city of Milwaukee, U.S.A. His instructions are to visit England and other European countries to make inquiries in order to guide the municipality in establishing corporate undertakings for dealing with monopolies such as electricity, gas and water. Mr. Mills is to visit the principal cities where municipal enterprises have been most largely undertaken, and to inquire into the plans adopted of making a beginning in such enterprises and the methods of financing them.

The Board of Trade has appointed Dr. Alexander Russell, M.A., M.I.E.E., Principal of the Electrical Training Institution, Faraday House, to be an Electric Inspector to Surbiton.

CATALOGUES AND PRICE LISTS.

The following catalogues and price lists have been received:—

Messrs. Babcock & Wilcox, Ltd.: Neat illustrated booklet, giving full particulars of various types of boilers, patent chain grate stoker, steel chimneys, feed water heaters, and patent water softening plant.

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Iron and Steel and Electric Power.*

With Special Reference to the Economical Speed Regulation of the Motors.

By J. J. Elink Schuurman (Baden, Switzerland).

For some time serious attention has been given to the most economical manner of utilising blast-furnace gases for all processes in the manufacture of steel which require mechanical energy. Economical utilisation necessitates centralisation of the power, for which electricity furnishes the most efficient and convenient means.

Utilisation of Waste Gases.

At the present time steam turbines or gas engines are used for driving the electrical generators. Gas engines are more economical from a thermo-dynamic standpoint, especially as the efficiency of steam boilers, using blast furnace gases for fuel, is very low. For the production of 1 kw. hour by a gas engine about 4,500 calories (17,850 British thermal units), equal to about 180 cu. ft. of gas, are needed, whereas in the case of steam turbines about 9,000 calories (35,700 British thermal units), or about 360 cu. ft. of gas, are necessary for the production of the same amount of energy. Against the better heat economy of the gas engines must be put the lower first cost of steam turbine installations, amounting to approximately 25%. The latter allow, moreover, of installing considerably larger units, the entire operation of the plant becoming much simpler and capable of being easily superintended. Also the room occupied by steam turbine sets, attendance necessary, and oil consumption are reduced. Further, steam turbines stand the shocks occasioned by sudden changes of the load much better than gas engines, which can be overloaded only to a small extent, and their parallel working is more efficient. It consequently depends on circumstances which drive is to be preferred, and a combined drive is often suitable. In Germany, for instance, several steelworks have gas power stations in which are installed one or more steam turbines. The latter, by taking up the overloads, lessen the danger of the gas engines falling out of step.

By the centralisation of the power production in an electrical central station it is possible to deliver superfluous quantities of gas, for which there is no use in the plant itself, to outside consumers, in the form of electrical energy. This may prove a means of increasing the income of the steelworks. There already exist several steelworks which supply neighbouring towns with light and power from this source.

It is also possible to connect the power station of the steelworks with some long-distance distributing station. Ordinarily the latter will supply energy from the steel plant. In cases of emergency, however, as, for instance, through interruption of the working of the blast furnaces, the long-distance distributing station will supply the missing energy.

In steelworks where there are no blast furnaces in the immediate vicinity, steam turbines have nearly entirely been adopted for the generation of energy.

System of Supply.

With regard to the choice of system of current supply, most of the older steelworks installed continuous current. Only the smaller equipments were driven electrically, and the distance over which the current had to be supplied was not great. For this purpose continuous current was very suitable, especially as continuous current motors have the advantage of being easy to regulate.

With the extension of electrical installations the distance over which electrical power was used increased. Also the electrical drive came into use for the larger consumers, for instance, in rolling mills, so that the distribution with continuous current became more and more uneconomical.

At the present time, owing to the extensive installations of modern steelworks, alternate current is usually adopted, it being possible with alternate current to conduct large quantities of energy over long distances with comparatively small loss. Its only disadvantage, until recently, lay in the fact of the impossibility of regulating the speed of alternating current motors in an economical manner. This disadvantage has since been overcome in several ways, which will be described later. First, the problem of speed regulation, which is of the greatest importance in the operation of steelworks, will be more closely described.

Speed Regulation of the Motors.

In regulation of speed a distinction must be made between speed reversal, and speed regulation in one direction of rotation. The reversal problem, as applied in the case of reversing rolling mills, has already been so often discussed that it need not be dealt with here. In speed regulation in a definite direction of rotation a distinction must be made between the adjustment of different no-load speeds with a slight drop of speed between no-load and full-load, the adjustment of different no-load speeds which drop to a certain adjustable extent between no-load and full-load, and a regulation which causes a large drop of speed when the load is applied, but does not permit of adjusting at various no-load speeds.

Furthermore, it is often required that the output should remain constant at all speeds. However, a constant torque over the entire range of speed regulation is generally sufficient.

How do these forms of regulation come into consideration for the different operations in iron and steel works?

Rolling Mills.—For the driving of rolling mills it is often necessary to obtain different no-load speeds, depending upon the rolling programme.

The sort of mill used will determine whether these speeds should remain constant from no-load to full-load, or whether a drop of speed is required. The latter will be the case for blooming or similar mills, with which considerable peak loads are experienced, which must be taken up by the use of rotating masses. For wire mills and the like, where the load remains fairly constant, a drop of speed is not necessary.

A constant output for all speeds is often required for mill operation—that is to say, an increase of torque at decreasing speed, which may lead to an increased production.

Blowers.—The drive of blast furnace blowers, and still more, of steelworks blowers, presents an interesting phase of the speed-regulation problem. Up to the present time reciprocating blowers, driven by reciprocating steam engines, or often by gas engines, have generally been used. Recently, however, high speed rotary blowers, which have certain advantages when compared with reciprocating blowers, have more and more been adopted. In comparing the respective usefulness of the two types of blowers, reliability of operation first comes into consideration. In this respect, absence of all mechanism liable to wear, less attendance required, continuous and steady delivery of air, give the rotary blower a considerable superiority over the reciprocating. Further, it occupies much less room, and its first cost is smaller.

The opinion often expressed that the efficiency of the reciprocating blower is higher than that of the high speed rotary blower, has arisen from the incorrectness of the methods used for determining the efficiency of the former type. When the comparison is properly made, and identical methods of testing are employed for both types of blowers, it will be found that the efficiency of the high speed rotary blower is by no means inferior to that of the reciprocating.

When the speed is constant the high speed rotary blower produces a pressure which is practically independent of the volume of air delivered, the volume depending only upon the section of the tuyeres. A change of pressure can be obtained by varying the speed, and as the pressure increases approximately with the square of the velocity, compara-

* Paper read before the Iron and Steel Institute.

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tively small alterations in the speed will suffice to produce the pressure variations necessary for the operation. Thus the pressure curves of high speed rotary blowers can be brought to higher or lower levels by an increase or decrease of the speed, while the efficiency curves remain practically the same. (See Fig. 1.)

Rotary blowers require high speeds, consequently for driving them the steam turbine receives first consideration, especially as it meets the requirements of regulation to a great extent. The exhaust steam turbine is particularly favourable for this purpose, as it is capable in a much higher degree than the reciprocating steam engine of making use of the energy of the steam down to the lowest possible vacuum. When it is considered that the exhaust steam of rolling engines, which in many cases escapes to the atmosphere, can be utilised in exhaust turbines, and the heat it contains converted into mechanical energy as far as technically possible, the economy of such a drive will become self-evident.

In the case where a large gas engine power station exists, it may prove to be more suitable, on account of the better centralisation obtained, to drive the blowers electrically. Also for reserve blowers, which are necessary where the main blowers are driven by gas engines, the electrical drive will be of advantage, on account of its low cost.

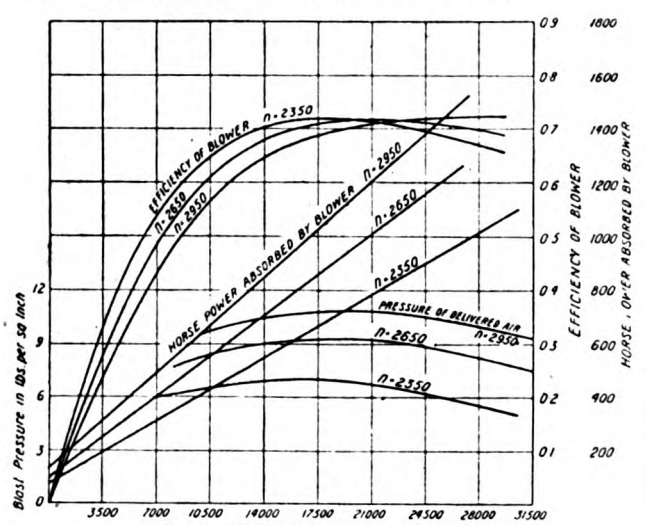

FIG. 1.—CHARACTERISTIC CURVES OF A HIGH-SPEED ROTARY BLOWER FOR A NORMAL OUTPUT OF 23,000 CUBIC FEET OF FREE AIR PER MINUTE AT A PRESSURE OF 10 LBS. PER SQUARE INCH.

As driving motor only a high speed motor can come into question, which, except in special cases, should meet the requirements of an easy and economical speed regulation. The needs of the blast furnace blowers are comparatively easy to meet. Steelworks blowers, however, require to supply pressures from 5 to 35 lbs. per sq. in., as well as a widely varying volume of air. The driving motor should consequently in this case permit of a wide range of speed regulation, and preference must be given to that form of speed regulation for which the once-adjusted speed does not vary between no-load and full-load.

Minor Operations.—Besides the principal operations above mentioned, viz., rolling mills and blowers, various small drives requiring regulation of speed come into account. Mention should be made of live roller-beds, cranes, transporting apparatus of all sorts, hoists, hydraulic pressure pumps, etc. Most of these drives must also be reversible.

RESISTANCE REGULATION FOR INDUCTION MOTORS.

As already mentioned, the continuous current motor adapts itself in a favourable manner to the different forms of speed regulation. The most varied characteristics may be obtained with the shunt, compound, and series motor. However, the use of continuous current is limited in large plants for the reasons given before, so that alternate current has now generally been adopted.

The best known and most extensively used alternating current motor is the three-phase induction motor. It has the great advantages of simplicity and safety of operation, but in its original form the speed, which depends upon the number of poles and the supply frequency, cannot be economically regulated. The simplest means of varying the speed is to insert an adjustable resistance—known as a slip resistance—into the rotor circuit. This method has often been used for regulating the speed of rolling mills, but is very uneconomical, because an amount of energy, which is proportional to the percentage of the regulation, is lost in the slip resistance. When, for instance, the speed is decreased to 30% below normal, 30% of the energy taken from the line is lost. In consequence the efficiency is very low.

Another disadvantage of this system of regulation is, that for a once-adjusted slip resistance the speed changes to a very great extent with variations of the load, and rises to practically its normal value at no-load. This running back to the synchronous speed can be of great inconvenience in the operation of rolling mills, as it is just when running light that a low speed is required in order that the rolls may be sure of getting a hold on the steel.

POWER FACTOR.

The power factor is another characteristic of the induction motor to which close attention should be given. It is the power factor which determines the proportion of the total current generated which is available for power purposes; a low power factor means larger and more expensive generating plant, increased losses throughout the system, and often inferior pressure regulation.

Exact measurements have shown that industrial plants which are driven by induction motors have usually a power factor between 60 and 85%, although the upper limit is but seldom reached. Rolling mills are examples of installations with a low power factor. The reasons for this are that low speed motors (which naturally have a low power factor) are commonly employed, that the load has an intermittent character, and that rolling mill motors have large air gaps for mechanical reasons, so that their magnetising current is large.

From the foregoing it results that the induction motor in its original form possesses disadvantages for the driving of iron and steel works machinery. From a suitable motor should be expected an easy and efficient speed regulation, and, if possible, compensation of the phase difference, resulting in a favourable power factor. Recently certain systems of economical speed regulation for induction motors, which fully meet these requirements, have come into use.

SCHERBIUS SYSTEM OF REGULATION.

The first of these systems was brought forward by Dr. A. Scherbius. Instead of connecting a variable resistance to the slip rings of the induction motor, these are connected with a so-called "regulating motor," which is of the three-phase commutator type (see Fig. 2). Its purpose is to make use of the slip energy which was formerly lost in resistance, and to convert it into mechanical energy. It is generally shunt-excited, and is so wound that it possesses no inductance, and hence for all practical purposes can be regarded as operating as a continuous current machine.

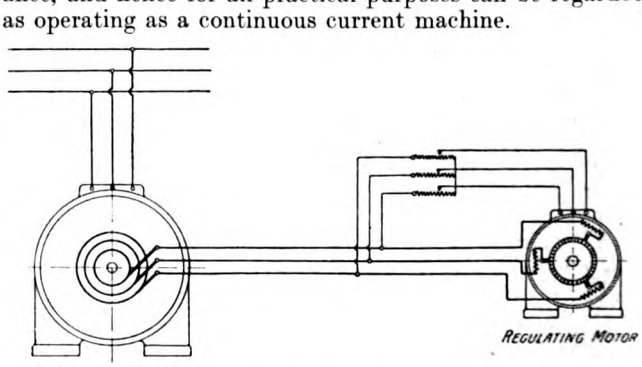

FIG. 2.—PRINCIPLE OF SCHERBIUS REGULATION.

The speed regulation of the main induction motor is obtained in a simple manner by adjusting the excitation of the commutator motor. As is well known, the slip of an induction motor is proportional to the rotor voltage. When the rotor voltage is forced by exterior means to increase, the speed will have to decrease. For a strong excitation of the regulating motor the speed of the main motor will consequently be low, whereas for weak excitation it will be in the neighbourhood of synchronism. As the armature voltage of the regulating motor, which differs from the rotor voltage of the induction motor only to the extent of the

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ohmic drop in voltage, merely depends upon the excitation, the speed will remain constant from no-load to full-load. When a drop of speed is required between no-load and full-load, in order, for instance, to make use of the fly-wheel effect of the rotating masses, the regulating motor is provided with a compound exciting winding. As in the case of a continuous current compound motor, the speed will then drop from no-load to full-load over a certain adjustable range. Finally, a series excitation can be provided, which entails a form of regulation similar to that by resistance.

The question how the slip energy which the regulating motor converts into mechanical energy can be most favourably recovered can be solved in two different ways. In the first place, the regulating motor can be coupled mechanically to the main motor, so that the slip energy is given back to the main driving shaft (see Fig. 3). In the second place, the regulating motor can be coupled with a small induction generator. This regulating set converts the slip energy into electrical energy, and returns it to the line (see Fig. 4). The first arrangement, in which the regulating motor is coupled directly or by means of a belt to the main motor, is in

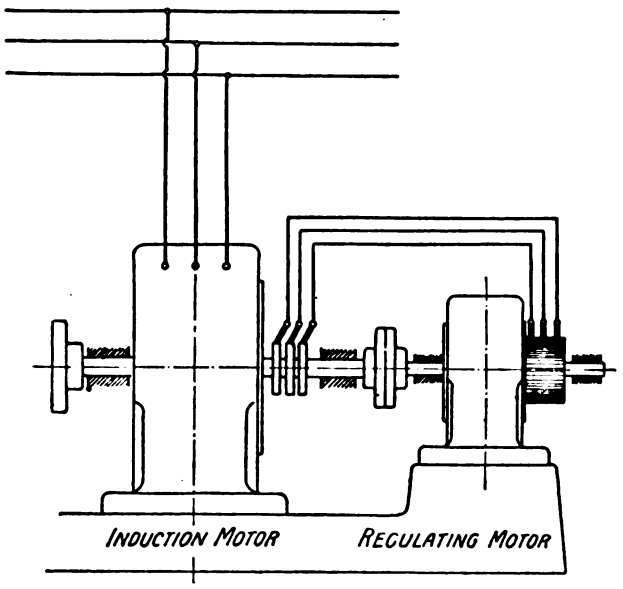

FIG 3.—SCHERBIUS REGULATION WITH DIRECT-COUPLED REGULATING MOTOR.

general the better one, as the available energy on the main shaft remains constant—that is, with decreasing speed the torque can be increased. In case of the arrangement with the regulating set only a constant torque is available (as in the case of regulation by resistance), so that the output must decrease with decreasing speed. Further, the total efficiency is more favourable in the case of mechanical coupling between the regulating motor and the shaft of the main motor. However, this arrangement is not always possible, as with it the regulating motor must follow the speed fluctuations of the main motor, and on this account becomes too expensive for very wide ranges of regulation. In such cases the regulating set, which runs at constant speed, is preferable.

A great advantage of the Scherbius regulating system lies in the possibility of extending the regulation above synchronous speed. The result is, that the regulating motor can be built smaller than is possible with regulation solely under synchronism. In order to obtain over-synchronous speeds it is only necessary to reverse the direction of the excitation of the regulating motor. The latter then runs no longer as a motor but as a generator. It does not take up slip energy, but, on the contrary, delivers slip energy to the main motor. The possibility of running above synchronism can also be of value for reaching very high speeds, as is sometimes necessary for rotary blowers, rotary compressors, etc. It should be realised that with a frequency of 50 cycles per second, 3,000 revolutions per minute is the highest speed which can be obtained in the ordinary way, this being the synchronous speed of a two-pole motor. The next lowest speed is 1,500 revolutions per minute for a four-pole motor. The advantage of being able to obtain intermediate speeds, and, above all, speeds over 3,000 revolutions per minute, is obvious. Such a degree of speed regulation has hitherto been unattainable with induction motors.

The Scherbius system also permits of compensating the phase difference between current and voltage of the main motor, so that its power factor becomes unity, independently of the load. By a small change in design, the regulating motor can be made to supply the magnetising current necessary for the excitation of the main motor. The generators at the power station, and the transmission line, are then relieved from delivering this wattless current. If necessary the regulating motor can also be designed to supply the excitation for other motors on the line, and thus will contribute still further to raise the power factor of the entire system.

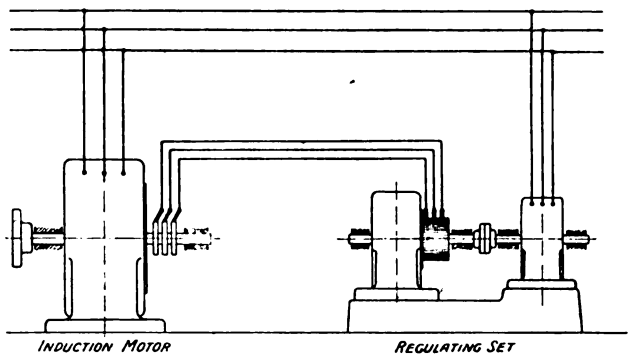

FIG. 4.—SCHERBIUS REGULATION WITH REGULATING SET.

It has been mentioned that the regulating motor is of the three-phase commutator type. The simplest variable speed three-phase motor would be such a commutator motor used directly as a main motor, if it could be constructed for the normal working conditions. However, certain difficulties with respect to good commutation stand in the way of building such motors. The higher the frequency and the larger the output, the greater are these difficulties. A commutator motor for several thousand horse-power, for instance, as often required in rolling mills, could not be built at the present time, although in the next few years considerable development may be made in this direction. The regulating motor described is connected to the rotor of an induction motor, in which the frequency is low, and, moreover, its output is small when compared with the output of the main motor. Again, the rotor voltage of an induction motor can be chosen at will within wide limits, even when the stator is directly connected to the high voltage line, and thus the voltage of the regulating motor can be kept low, which still further facilitates its design.

The Scherbius system may be used for new installations, as well as in connection with induction motors which already exist.

KRÄMER SYSTEM OF REGULATION.

A second system, designed to bring about an economical speed regulation of induction motors, is shown diagrammatically in Fig. 5, and is due to Mr. C. Krämer. The slip rings of the main motor are connected to a rotary converter which changes the slip energy into continuous current. The latter is used to feed a continuous current shunt motor, which is coupled mechanically to the induction motor and returns the slip energy to the main driving shaft. The speed is regulated by varying the resistance in the shunt field of the auxiliary motor. When resistance is cut out, the armature voltage, and the continuous current voltage of the rotary converter, will increase. At the same time the alternate current voltage at the slip rings must increase, as the continuous current and alternate current voltage of a rotary converter stand in a fixed relation to each other. The speed of the main motor will thus decrease.

The speed of the rotary converter depends upon the rotor frequency of the main motor, and is proportional to the regulation. When the main motor runs at normal speed, the slip and rotor frequency are small, and the rotary converter turns very slowly; when the regulation is 50%, the rotor frequency is 50% of the line frequency, and the speed of the rotary converter increases proportionally. As the voltage at the slip rings should also increase in proportion to the regulation, and as in general voltage and speed are proportional values, it results that the design of the rotary converter is practically independent of the amount of speed reduction required. For this reason the Krämer system is very suitable for wide ranges of regulation.

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The available output remains constant over the entire range of regulation, as the slip energy is returned to the main driving shaft.

The power factor of the main motor may be improved to unity by adjusting the excitation of the rotary converter accordingly.

A disadvantage of the Krämer system as compared with the Scherbius system is its greater complication. More machines are necessary, and a special source of continuous current energy is required for their excitation. Also, it cannot be so easily used in connection with existing motors.

Déri Motors.

The single-phasecommutator motor of the Déri type offers a third solution to the problem of economical speed regulation. It comes into question especially for smaller outputs, and has the advantages of extreme simplicity and ease of regulation. This motor belongs to the repulsion motor class, and its principle is shown in Fig. 6. For each pair of poles the motor has four brush-holders, two of which are fixed and two movable. Each set of fixed brushes is connected electrically to a set of movable brushes. At rest, both are in line on the commutator in the pole-middle.

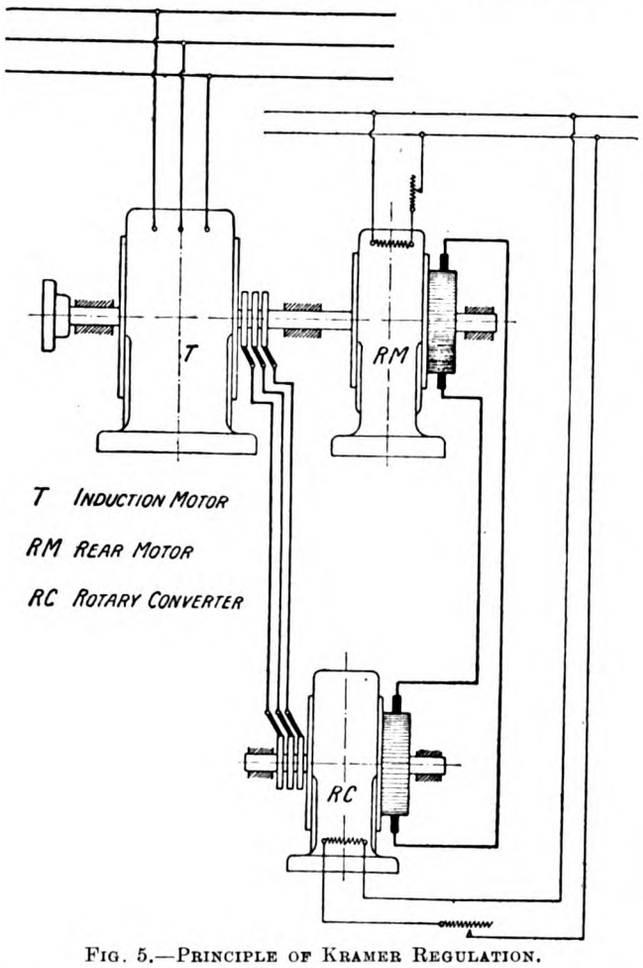

Fig. 5.—Principle of Kramer Regulation.

When the movable brushes are shifted to the right, the motor turns to the left, and *vice versa*. The result is that a reversal is possible without any switching over. The farther the movable brushes are shifted from the zero position, the more the torque increases. Normally the motor can start with two to two and a half times the normal torque and possesses a large overload capacity. When required, it may be designed for still higher starting torques.

The stator and rotor are in no way connected, so that it is possible to keep the rotor voltage low. This seldom amounts to more than 100 volts at standstill, and decreases to 10 volts and less when the motor is running. The result is great safety of operation; the brushes can without danger be renewed during running. As there is no connection between stator and rotor, the stator can be directly connected to high tension circuits. The insulation is easy to effect, as the winding is simple and no inter-crossing occurs. The rotor has a normal continuous current winding without any complications.

The motor has a series characteristic, or more exactly, an infinite number of such characteristics, each being for a certain position of the brushes (see Fig. 7). It is consequently possible with any load, including running light, to adjust the brushes for any required speed. By moving back the brushes over the zero position during running, regenerative control can be obtained. The farther the brushes are moved back, the stronger will be the braking action. The efficiency of regenerative control is similar to the efficiency of normal operation.

As said before, the great advantage of the Déri motor lies in its extreme simplicity: the entire regulation—starting, reversing, and adjusting of all speeds between standstill and 10% above synchronism—is effected merely by shifting the brushes. Beyond a two-pole stator switch no other switches, transformers, etc., are needed. In the case of smaller drives which require reversal, the Déri motor should be compared with an induction motor with starting resistance, controller, and reversing switch. The importance of the absence of all such apparatus is self-evident. Further, an absolutely continuous regulation is superior to regulation by means of controllers and resistances or regulating transformers, with which a great degree of sub-division is not possible.

When the output is small, the single-phase Déri motor will hardly affect the even distribution of the load on the three phases of the system, especially if there are several such motors which can be divided over the different phases. But when large motor outputs come into question, it is better to make use of a double commutator motor, which electrically consists of two Déri motors, mechanically built into one. By a simple method of winding, such a double commutator motor can be directly connected to a three-phase line, and exact measurements have proved that with it the load is quite as equally distributed over the different phases as in the case of a normal induction motor, while such a double commutator motor retains all the good qualities of the Déri motor.

Practical Applications of the Scherbius, Krämer, and Déri Systems of Speed Regulation.

Rolling Mills.—Rolling mill motors require large outputs, for which the induction motor is the most appropriate. For its regulation both the Scherbius and the Krämer systems are suitable.

At the Differdingen Steelworks (Luxemburg) a wire mill is in operation, driven by an induction motor of 2,000 h.p.

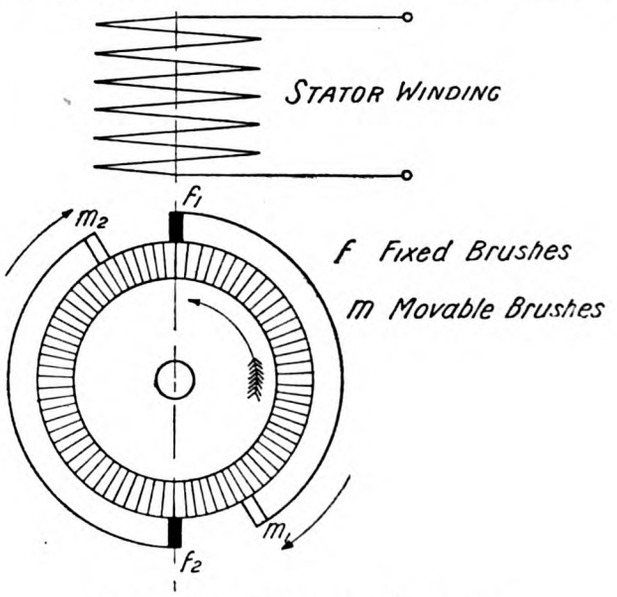

Fig. 6. Principle of the Déri Motor.

and 150 r.p.m., which is regulated by means of a Scherbius regulating set of 240 k.v.a. and 750 r.p.m. The latter produces a 10% drop of speed between no-load and full-load. At the Deutscher Kaiser Steelworks, Bruckhausen, Germany, a bar-mill is driven by an 1,800 h.p. induction motor for 375 r.p.m., 50% regulation, and 5% drop of speed between no-load and full-load. The Scherbius set is built for 400 k.v.a. and 750 r.p.m. Several other installations are in course of construction.

The Krämer system is also already in use in a few rolling mills.

When a new rolling mill is installed, it often cannot be determined beforehand what will be the most favourable

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speed for the process. In such a case it is advisable to design the driving motor with a sufficiently wide margin. Should its speed prove to be too high, one or other of the described systems of regulation permit of reducing it without affecting the efficiency of the installation or its power factor, while apart from this speed reduction the driving motor can deliver the full output for which it was designed.

For small rolling mills of special type, such as plate-bending machines, corrugated tube mills, etc., the Déri double commutator motor does good service, on account of the technical advantages above referred to. For the Borsig Works in Upper Silesia, two double commutator motors, each for 250 h.p. normal and 400 h.p. maximum output, are at present in course of construction for the operation of a corrugated tube mill.

Blowers.—For the operation of blowers at variable speed, the Scherbius system with regulating set is often very useful. The arrangement with direct-coupled regulating motor is in this case less favourable because of the high speed of blowers. High speeds always entail certain technical difficulties for commutator machines. Moreover, the main advantage of the direct-coupled regulating motor, viz., to keep the output constant, is of no value with blowers, fans, and similar machines, for which the required output greatly decreases with decreasing speed.

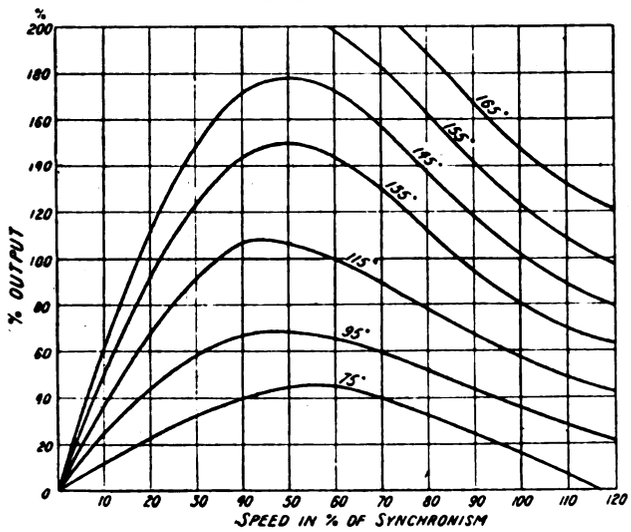

FIG. 7.—CHARACTERISTIC CURVES FOR THE DERI MOTOR.

At the Gelsenkirchener mines they have a fan motor of 850 h.p., 365 r.p.m., the speed of which can be regulated to the extent of 26%. At the Skinningrove Iron and Steel Works, Yorkshire, they have an electrically-driven blast furnace for an output of 24,000 cu. ft. of air per minute, and a pressure of 7 lbs. per sq. in., the speed being 2,360 r.p.m., this being a case in which the special working conditions did not call for speed regulation of the driving motor.

Minor Drives.—The Déri motor, either as single or as double commutator motor, is very suitable for most of the auxiliary drives in steel mills, which require regulation.

In the first place, the drive of those live rollers which require constant reversing must be mentioned. Their starting conditions are severe because of the acceleration of all the moving parts. To this class of service the Déri motor, with its high-starting torque, is well adapted.

For the operation of blast furnace hoists the Déri motor is to be preferred to the induction motor on account of its smooth acceleration and the smaller current peaks which it produces, while again it permits of an entirely automatic operation. The furnace labourer, who puts the barrows in the cage at the ground level, closes a small switch to start the lift. The mechanism then takes care of itself, and the hoist stops exactly at the right level, so that the barrows may be conveniently wheeled off.

The Déri motor adapts itself in particular to the operation of travelling cranes. Its use reduces the controlling apparatus in the driver's cage to three levers, or hand-wheels, one for the lifting motor, one for the traversing motor, and one for the cross traverse motor. Each lever, or hand-wheel, serves to shift the brushes of one of these motors. As the distance between the driver's cage and the crab is variable, a special mechanical transmission is required for shifting the brushes of the motors which are mounted on the crab. As a rule, a square shaft and a moving socket with a gear wheel are used for this purpose. The driver is able to displace the brushes always according to the starting torque required, and thus the current demand can be kept at a minimum. The driver is also able to adjust the brushes to any speed he needs.

The greater part of the brake equipment usually supplied can be omitted, as electrical braking and regenerative control can be used. As a rule, only the lifting motor is fitted with a mechanical brake. This brake is often not used during normal operations, but is of advantage when, during long intervals, the load has to be held at a certain height. The mechanical brake can then be applied and the lifting motor disconnected in order to save electrical energy.

CONCLUSION.

On the foregoing pages it has been shown that economical speed regulation for alternating current motors, both of large and small output, may nowadays be obtained. It has also been explained that the inherently low power factor of iron and steelworks installations can be greatly improved, when one or more induction motors of the plant are arranged for speed regulation according to the Scherbius or Krämer systems before described.

Owing to these improvements, the three-phase system of current distribution will more than ever meet the requirements of an economical utilisation of the blast furnace gases.

The energy available in these gases furnishes a large source of power. It must be borne in mind that from the gases arising from the production of 1 ton of pig iron, a gas engine power station will develop 400 kw. hours, when it is assumed that 60% of the total gas production is consumed by the blast furnaces themselves. The utilisation of this source of power is of the greatest importance for an economical production.

Also from the standpoint of national economy this question is of vital interest, as it is closely connected with the conservation of the country's coal supply. With the annual production of pig iron amounting to 10,000,000 tons, the use of the waste gases permits of a saving of 2,500,000 tons of good coal. This saving becomes possible only through the centralisation of the power production and the distribution of energy by means of electrical transmission, and nowadays it can be utilised to the utmost by such means, with the help of the efficient motor drives referred to in this paper.

COMPARATIVE DURABILITY OF BRAKE SHOES AND TYRES.*

By J. W. Dawson, A.M.I.E.E., Assist. Engineer, Bradford Corporation Tramways.

Many opinions have been put forth respecting the wearing effect upon steel tramway tyres by brake shoes. Until quite recently no systematic tests appear to have been carried out to demonstrate the relation between the material of the shoe and its effect upon the tyre, and to indicate which type of shoe should prove most economical in use.

The amount appearing in car repair and maintenance costs for the upkeep of brakes and wheels is quite sufficient to warrant a very close consideration of the inter-relation of these two indispensable parts of the equipment.

Laboratory and service tests upon the durability and braking properties of shoes have been extensively carried out by the Master Car Builders' Association of America, the laboratory tests being made upon apparatus provided by the association, and installed at the Burdue University, U.S.A. As the result of these tests, standard specifications for brake shoes have been adopted. Their results, are, however not applicable to the conditions prevailing in this country. In the United States of America, power brakes are almost universally used on cars, and speeds are high. The tests have naturally been to determine the most suitable shoes for their requirements, and carried out on steel tyres with high pressures per square inch of shoe at a speed of 65 miles per hour. Until last year they had not attempted to ascertain wheel wear, stating in

* Paper read at the Ninth Annual Conference of the Municipal Tramways Association.

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their report—Vol. 41, 1907, Master Car Builders' Association, page 142, par. 10 :—

"A Missing Factor.—It is a matter of regret that no measure has yet been made which will disclose the wear of the wheel under the influence of the shoe. To secure such a measure, if will be necessary to have a balance of sufficient capacity to weigh the wheel, and of such delicacy as to indicate differences in weight as small as one five-hundredth part of a pound. No such balance is now available at the laboratory. The possibility that some of those which show high performance may have been protected from wear at the expense of the wheel, makes it highly desirable that precise information be had upon this point."

They have now constructed such a weighing machine, and have carried out tests with several of their approved shoes during the past year. In their report they state :—

"After consideration the Committee has concluded that no serious wear of the wheels is to be expected from any of the shoes now in ordinary service, and it therefore considers any recommendations concerning wheel wear to be unnecessary."

While these conclusions may be correct for the shoes and conditions ruling them, the tests which are detailed in this paper show clearly that considerable tyre wear is effected by many of the shoes in use in this country, and until the ideal shoe is produced which will give a workable coefficient of friction with no wear, either of itself or the tyre, considerable care should be exercised in selecting brake shoes which will give the most efficient and economical results.

The investigation recorded in this paper were undertaken with the object of ascertaining the comparative durability of the various grades of brake shoes used on tramcars in this country, together with their wearing effect upon steel tyres, recording at the same time any observed features or properties of the shoes under test which appeared to have a bearing upon the durability of the shoes and tyres.

Brake Shoes.

Twenty different grades of shoes have been tested ; they were chosen to cover the range of shoes in actual use in this country. A few shoes have been obtained of special metal in order to complete the series of grades. The shoes have been cast of a similar pattern to enable them to be tested on tramcars with equal equipments and weights for service tests. The shoes were numbered when received, and may be classified as follows :—

No.			
1.	Soft Grey Cast Iron	Average hardness	47.
2.	„ „ „	„ „	46.
15.	„ „ „	„ „	41.
14.	„ „ „	„ „	38.
16.	Hard Grey Cast Iron..	„ „	51.
6.	„ „ „ stated to have ends chilled, but this was not found to be so when tested for hardness	„ „	43.
5.	Mottled Grey Iron. Intermittent Chills ..	Unchilled Metal	49.
		Chilled „	63.
19.	Part Chill. The whole face was chilled with about 1½", which was unchilled	Unchilled Metal	34.
		Chilled „	70.
7.	All face chill	.. .. ..	66.
8.	„ „	.. .. ..	74.
18.	„ „	.. .. ..	64.
20.	„ „	.. .. ..	66.
4.	Hard White Iron	.. .. ..	61.
23.	„ „ „	.. .. ..	62.
24.	„ „ „	.. .. ..	75.
9	Mottled Cast Iron Body with three White Iron Inserts	.. Body Metal	46.
		.. Inserts ..	56.
17.	Mottled Cast Iron Body with Soft Steel Inserts	.. Body Metal	55.
		.. Inserts ..	28.
21.	Mottled Cast Iron Body with Soft Steel Inserts	.. Body Metal	66.
		.. Inserts ..	30.
22.	Mottled Cast Iron Body with expanded Steel Inserts	.. Body Metal	60.
		.. Inserts ..	44.

The last column gives the average hardness of the shoe face after the frictional tests.

Service Tests.

Comparison of the life of brake shoes and tyres on one tramway with those obtained on other tramway systems is of very little value, so many factors operating which entirely vitiate the results, such as difference in gradients, nature of the road grit, track brakes, speed, average number of stops per mile, use of rheostatic or magnetic brakes for service stops, etc., but comparison of various grades of shoes can with advantage be carried out on the cars of any one system. The results will not, of course, be of quantitative accuracy, but will give an indication of the difference between, say, a standard brand of shoe and other types used at the same time. For purpose of comparing results obtained with those on tram-cars under service conditions with those obtained in the Works Laboratory under uniform conditions, tests have been made by this method. In service tests one particular make of shoe was adopted as the standard for comparison. One standard shoe and one with which it is to be compared being fitted to the wheels at one end of the car, and similar shoes fitted at the other end, the same grade shoe being at diagonal positions on the truck. one of each grade of shoe thus acting upon each axle and making the retarding effort per axle equal, the shoes being accurately weighed before fitting. The car is run until some of the shoes are worn out ; they are then taken off and again weighed. The amount of metal worn from the test shoes to that worn from the standard shoes will be in inverse proportion to their durability when run with equal pressures upon each shoe ; but it must be particularly noted that the shoes with the highest coefficient of friction will have done the most work, so this method of testing is decidedly favourable to shoes having the lowest coefficient of friction. If the circumferences of the tyres are measured before and after the rest, it will be ascertained which shoes have caused the greatest tyre wear. Average of measurements from several cars should be taken. Results obtained by this method are shown in Table, as follows :—

Service Tests of Shoe and Tyre Wear.

No. of Shoe	Description.	WHEELS. Miles per 32th Radial Wear.			SHOES. Miles per lb.		
		Test shoe	Standard	Ratio	Test shoe	Stand'd	Ratio
4	Cast White Shoe	6060	10954	·55	966	447	2·16
9	Cast Iron with White Iron Inserts	12665	9900	1·30	296·7	722	·41
15	Cast Soft Grey	14307	5830	2·45	214	834	·26
2	Cast Soft Grey	14630	8955	1·63	181	5332	2·94

Comparison of these tests with those obtained with the test apparatus under laboratory conditions prove that the results obtained on the latter correctly indicate the comparative wearing properties of shoes and tyres when run under ordinary service conditions, with the exception of shoe No. 4, of which mention is made later. Shoes Nos. 9, 15, and 2 give results of the same character in both tests. Examination of the Table shows very clearly that by this method of comparison the life of the standard shoe varies with the coefficient of friction of the shoe with which it is run. All the shoes in one set have equal pressures applied during braking, therefore those having the highest coefficient develop the greatest amount of retarding force. Each set of shoes must stand to itself, and can only be compared with other sets indirectly, say, by means of the percentage or ratio of the test shoe to the standard. Differences of tyre wear by various grade shoes are very noticeable. The author is of opinion that one cause of the differences in wheel diameters, so prevalent on tram-cars, may be the use of the brake shoes of uneven grades.

Another method is to fit up a number of cars with test shoes, keeping record of their mileage and loss in weight, also records of standard shoes on similar cars running concurrently on the same route and schedule if possible. This test, to be of value, should extend over a long period in order that running conditions may reach an average.

Adjustable Leverage—Ratio Brake Gear.

To accurately obtain comparative results of shoe wear and differences of tyre wear, it is absolutely necessary that each shoe should give the same retarding effort. To do this, the pressure applied to each shoe must be in inverse proportion to its coefficient of friction. This has been secured by means of the brake gear designed by the author. In use, shoes of equal grade are fitted on each pair of wheels. The leverage-ratio of the brake gear is adjusted by means of the links between the supplementary brake beams, in proportion to the respective coefficient of friction of the shoes, thus obtaining from each pair of shoes the same retarding effort.

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A car fitted with this gear has been running in ordinary service for a few months with shoes having different coefficient of friction respectively on each pair of wheels. So far, only one grade of shoe has been tested against the standard, the results up to date corroborate those of the laboratory tests. The shoes adopted as standard for the purposes of these tests have chills on face and back so arranged that about one-third of the shoe is chilled. The amount of chilled and unchilled metal is approximately equal throughout, arranged to give a uniform rate of wear and coefficient of friction during its life.

To form an accurate estimate of the value of a shoe from results of road tests is practically impossible, due to conditions stated in the Master Car Builders' Association Brakes Report of 1907, p. 176, viz. :—

> "An unsteady wheel pounding along over an uneven track, more or less elasticity in brake beams and brake connections and fluctuations in braking pressure, coupled with the varying contact between wheel and shoe with extremes of climatic conditions from cold to hot, and wet to dry."

To obtain standard and comparable results it becomes necessary, therefore, to carry out the tests with a true wheel revolving at a constant rate of speed with steady braking load, and a uniformly clean surface.

While these conditions are far removed from those existing on the road, the author submits that the results are quite in accordance with those obtained on service cars, and have the great advantage that shoes may be tested at any period of their life—their characteristics and subsequent value determined in a few hours. Tests may be uniformly repeated at any time.

Laboratory Tests.

For the purpose of carrying out tests under known conditions, apparatus illustrated on plate 1, fig. 1, has been installed, consisting of a 30 h.p. tramways motor, driving through the usual single reduction gear, an axle upon which is mounted a wheel-centre with steel tyre. The shoe is pressed upon the wheel by means of a lever carrying at one end a pan, which can be loaded with weights, and at the other end an adjustable radius rod and a dynamometer for registering the pull upon the shoe. A pulley running upon the tread of the wheel, drives a speed and mileage indicator. The apparatus is similar to that used in connection with the brake shoe tests for the Municipal Tramways Association Brakes Sub-Committee, and illustrated in their Report.

For measuring tyre wear an apparatus designed by the author is used. It consists of a means for determining the difference of volume reduction over a pre-determined area of the tyre surface, this by calculation giving the total amount of tyre removed. The apparatus comprises a die with means for forcing its inner face to a fixed radial distance from the centre of the wheel, the distance being determined by the outer faces of the die being in contact with two side faces of the tyre. In operation a piece of ductile metal (lead) is placed under the die which is then forced on to a turned face on each side of the wheel, the inner face of the die will thus be a fixed distance from these faces, and the thickness of the lead will be equal to the distance between the inner face of the die and the surface of the tyre, the lead following exactly the conformation of the wheel face. In the die are two small recesses, which form projections on the back of the test pieces. These projections enter into holes in the block of the cutting die, ensuring accurate cutting of the test pieces. After being removed from the die, the test pieces are cut to 0·5″ wide, a test piece being taken at the beginning and close of each run. These cut pieces are weighed on a chemical balance, the difference in weight of the two pieces equals the weight in lead of the volume of tyre removed per 0·5″ of the tyre circumference, and is calculated into equivalent weight of steel worn off the tyre by the formula

$$\frac{\text{Weight of Lead (diff.)} \times \text{Circ. of tyre in inches} \times \text{Sp. Gr. Steel}}{\text{Width of test piece} \times \text{Sp. Gr. Lead}} = \text{Weight of tyre loss.}$$

The tread portions of the shoes only are used, the flanges being removed in order to prevent uneven readings due to side pressure or wedging of the wheel flange in the groove of the shoe, the wearing face of the wheel being flat, the shoe bearing upon the centre portion only.

Particulars of Test Apparatus and Conditions.

Wheel tyre, 33″ diam. × 3½″ wide, made from Siemen's Open Hearth Acid Steel test piece from a tyre of the same cast giving 56 tons maximum stress, 14% elongation in 2″.

Motor. 30 h.p. Series Traction. Equivalent speeds during tests, 10 miles per hour.

Weight on Shoe. Wet Test. Adjusted to give a pull on the shoe equal to one-fourth of the retarding force required to balance the acceleration due to gravity of a four-wheel, 10-ton car, descending a 1 in 9 gradient at a speed of 10 miles per hour. If applied to the car on the level, this would be equal to a retardation at the rate of 3·6′ per sec. per sec., and would stop the car from 10 miles per hour in 4·09 seconds in a distance of 30 ft., neglecting any retardation due to the friction of the car or other forces.

Weight on Shoe. Dry Test. One-half of that used in the wet test, this lesser weight was used in order to allow of a long run to be made without the temperature of tyre or shoe rising sufficiently to effect the coefficient of friction.

Duration of Tests.—Wet Tests, 4 to 5 hours.
Dry ,, 2 hours.

During the wet tests the lower portion of the tyre was run into a trough of water, a stream of cold water impinging upon its surface near the shoe, the trough having an overflow for maintaining the water at a constant level.

Dynamometer. Spring type, non-recording.

Readings taken at 10 minutes intervals and averaged.

It may be noted here that the steadiness or otherwise of the dynamometer index varied with the amount of tyre wear; in the case of small wear it was steady during the whole run, but with large amount of tyre wear the vibrations of the index were so violent that it was most difficult to obtain readings, screechings with very heavy wear being continuous and decidedly unpleasant.

Having ascertained the value of shoes in terms of shoe and tyre wear, it becomes necessary to consider their economical value in order to determine which is the cheaper to wear, shoe or tyre. Mr. J. A. Panton has stated in his paper on "Brake Shoe Standardization," in the Tramway and Light Railway Association Official Circular, May, 1910, page 1161 :—

> "it is cheaper to wear out brake shoes than wheels, which are more costly."

The cost of brake shoes consists of material purchased, plus labour expended during their life, minus value of scrap; and similarly the cost of tyres, with the addition of charges for tools and power. The costs being calculated for shoes and tyres used on four-wheel, single-truck cars, the tyres being of sufficient thickness to allow of re-turning once during life, *i.e.*, after 40,000 car miles run, the cost taken for comparison being that of one pound of useful metal. The price of ordinary brake shoes ranging from £5 to £10 per ton, £8 10s. 0d. has been taken as their average price.

Shoes.

Weight of four shoes, 112 lbs., @ £8 10. 0d. per ton ..		0	8 6
,, scrap, 50%. 56 lbs., @ £2 10s. 0d. ,, ..		0	1 3
		0	7 3

Labour.

Removing worn-out shoes and fitting new set	1 hour.		
Average time setting up, chipping flanges where necessary, half an hour × 24 times = once per 1/16″ radial wear.. .. =	12 hours.		
Total time @ 6d. per hour =	13 hours	0	6 6

s. d. 13 9 / 5 6 = Total cost 56 lbs. useful metal 0 13 9

= Cost per lb. useful metal = 2·94d.

Tyre.

Weight rolled blank..	290 lbs.	Cost	1	12 4
Removed by boring	10 ,,			
Profile turning ..	5 ,,			
Half life re-turning ..	20 ,,			
Scrap weight ..	87 ,,			
Total Scrap Weight..	122 lbs.	@ £3 per ton =	0	3 3·21
Net useful metal ..	168 lbs.	.. .. ..	1	9 0·79

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LABOUR.

Boring..	2¾ hours.			
Turning	2¼ ,,			
Re-turning half life ..	2¼ ,,			
Shrinking	¼ ,,			
Removing from centre	¼ ,,			
Total labour	7¾ hours @ 34/- for 53 hours =	0	4	11·64
Gas foreheating		0	0	1·5

STANDING CHARGES.

Boring Mill or Lathe, £250 @ 15 years ..	£16	13	4
Average Interest @ 4%	5	0	0
Tools and Repairs @ 20%	5	0	0
	£26	13	4

50 weeks. 53 hours = 2·650 hours.

,, 26-13-4

$\frac{\text{26-13-4}}{\text{2,650}}$ = 2·41d. per hour × 7·25 .. = 0 1 5·47

Power 5 kw. hours @ 1·125d. × 7·25 hours .. = 0 3 4·78

£1 19 0·18

Cost per lb. useful metal, 1-19-0·18

$\frac{\text{1-19-0·18}}{\text{168}}$ = 2·78d.

Costs will vary with the price at which material is purchased and sold, together with cost of labour.

Omitting the turning of the tyre profile after shrinking would slightly reduce the cost. If the thickness of the tyres is only such that they will run out without re-turning, the costs would be higher on account of the higher proportion of scrap to useful metal, but against this must be put the increased cost of running the car due to the extra weight carried during the first half of the life of the thicker tyres.

Taking cost on the above basis, the value of shoes and tyres are approximately equal, and it may be considered immaterial which suffers the greater wear. In works where, by the use of improved machinery, the cost of labour on tyres is very low, it is possible that tyres will be cheaper than shoes, while conversely, where attention has been paid to obtaining the greatest possible wear from brake shoes, and scrap cut to minimum, they would stand at a lower cost per lb. of useful metal than tyres. On this assumption that the cost of shoes and tyres per useful lb. of metal are approximately equal.

One of the most striking features is the greater wear with dry runs, this being contrary to that obtaining on service cars, and may be accounted for by the test wheel being absolutely clean and free from any material which would prevent the tyre and shoe coming into perfect contact, such as exists on tyres when running on the track, the brake shoe and wheel consequently seize, and, according to their characteristics, one or both suffers increased wear.

Although there is this peculiar variation between the wet and dry conditions of tests, yet an approximation is quite apparent between the two. Considering the impossibility of having dry runs on the road track with perfectly clean surfaces, the writer is of opinion that the wet test, with its slight yet uniform lubrication by water, offers reliable and uniform means of comparison, and is quite adequate for the purpose of ascertaining the relative values of different grades of shoes. The results are given in the Brake Shoe and Tyre Wear Table in the order of their combined wear with wet tests, and shown graphically by thick black lines, the results of the dry tests being shown by red lines. The tested shoes may be divided into four groups, as follows :—

Cast Iron (unchilled shoes) numbered, 1, 2, 6, 14, 15, 16 and 23.

Cast Iron with all or part of face chilled, numbered 7, 8, 18, 19 and 20.

White Cast Iron shoes, numbered 4 and 24.

Cast Iron Body with Inserts, numbered 9, 17, 21 and 22.

Considering the results of tests of each group, it is immediately apparent that the individual shoes of each group vary considerably in their durability, as set out in the column showing number of lbs. wear per one hundred million foot lbs. of work done, the rate of wear of Soft Grey Iron shoes being more uniform than those of the other groups, but their wearing effect on the tyre varies greatly, being eight times more with shoe No. 6 than No. 15. Similarly with chilled shoes, No. 5 has two and a half times greater wear than No. 18, and its wearing effect upon the tyres is eight times greater. White Iron shows the greatest difference, No. 4 shoe having more wear than Soft Grey Metal shoes. From observations during the tests, the excessive wear of this shoe appears to be due to seizing between itself and the tyre, and is one of the few tests where the tyre suffered the greater wear. This is supported by the results of service tests with this shoe, page 368, where the shoe mileage per lb. of wear is 2·16 times that of the standard shoes and the mileage of the tyre is only ·55 of that obtained from the tyres braked by standard shoes. It is conceivable that the characteristics of the metal are such as to readily produce seizing with the tyre when run with perfectly clean surfaces and the two metals forced into intimate contact.

The writer has had to remove shoes of this type from service cars due to their seizing upon the tyres when descending long gradients, and causing the wheels to skid. From observations it appeared that under the action of continued braking the two surfaces became ground into perfect contact and seized together, this being clearly shown by the tearing marks upon the surface of the wheel, the anti-lubricating properties of this shoe upon a steel tyre will fully account for its short life under test.

The tests also show that shoes of the same grade, but from different founders, do not have the same frictional coefficient, durability, nor wearing effect upon the tyre. In investigating this difference one naturally considers first their respective hardness, especially in view of the statement of so high an authority as the Brakes Committee of the Master Car Builders' Association, who state in their Official Report, 1907, page 134 :—

> "The frictional effect and wearing qualities of each particular shoe depend entirely upon the proportion and texture of hard and soft material in its makeup."

and the statement of Mr. J. H. Panton in his paper previously mentioned :—

> "No matter what make of brake shoe is considered, if the proportion of hard and soft metal remains the same, the wearing properties will be equal with correspondingly equal wear and friction,"

To determine the effect of this property the shoes have been tested for hardness by means of a "Shore Scleroscope," this instrument represents the average hardness of full hard tool steel by 100, the scale being equally graduated to zero ; degrees of hardness may thus be considered as percentages of that of fully hardened tool steel. The hardness has been ascertained at intervals along the length of the shoe face, and the average of the readings given in the hardness column of the table. The hardness of shoes with part chill or inserts are shown graphically on plate 6. Examination of this property of the shoes demonstrates conclusively that shoes of equal hardness are not necessarily equal in durability, frictional coefficient, or effect on the tyre.

Chilled shoes Nos. 8 and 18, and White Cast Iron shoes Nos. 23 and 24, have a very similar effect upon the tyre, seizing being apparent though tyre wear is small. This seizing may be due to the whole of the carbon being combined and none of it existing in graphitic form. A comparison of tests Nos. 4 and 57 confirm this opinion. In No. 4 test the tyre surface was produced by the chilled face of No. 8 shoe ; and in test No. 57 by the soft metal of the same shoe after the chilled portion had been removed, the metal having the same quantity of constituent parts in both cases, with the difference that the carbon is totally combined in the chilled, and part combined, and part graphitic in the unchilled metal. The tyre surface of No. 57 test is typical of that produced by soft and medium Hard Grey Iron shoes. In No. 53 test the track produced by the White Iron inserts is plainly visible, the other portion of the surface being similar to that produced by Grey Iron.

Hardness having failed as a criterion of the durability of brake shoes, chemical analysis of the tested shoes, which had given extremes, under test, of durability and wearing effect on the tyre, was made by F. W. Richardson, F.I.C., F.C.S., Bradford City Analyst. Definite conclusions cannot be drawn from chemical analysis only, it is well known that metals which have the same chemical contents do not necessarily have the same properties, the various constituents combining differently in accordance with the materials used, methods of founding, and rate of cooling.

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	SHOE No.	ANALYSIS. Silicon %	Sulphur %	Phosphorous %	Manganese %
Shoe with minimum wear	7·	1·23	·31	·67	·52
Shoe wearing tyre least	23·	·79	·24	·02	·54
Shoe with maximum wear	1·	1·92	·18	·77	·74
Shoe wearing tyre most	4·	·18	·45	·45	·15
Shoe giving minimum combined wear	18·	·67	1·4	·34	·65
Shoe giving most combined wear	1·	1·92	·18	·77	·74
Shoe taken as standard for service tests	5·	1·33	·33	·63	·49
	6·	1·14	·06	·65	1·73

The author is of opinion that if, in addition to chemical analysis and physical tests, a microscopical research was made of the structure of shoes which have been submitted to service and laboratory tests, and combinations of their constituent parts would be revealed, which would indicate the particular structures producing the different characteristics of the shoes, and probably enable a standard specification to be drawn covering the essentials required for the most economical and efficient grade of brake shoes.

There were variations in the surfaces of tyres from car wheels which had run in ordinary service on routes with considerable gradients, where the brakes would be in continuous operation about one-third of their running time. The tread of the shoe is narrower than the tread face of the wheels; seizing and surface transverse fractures are only formed where the shoe brakes on the wheel, the marks being produced alike on flange and tread. The portion of the tyre not operated on by the shoe is free from these marks, which are similar to those produced by shoes upon the test tyre, and may be accepted as confirmation of the effect of shoes on steel tyres, as demonstrated by the laboratory tests. Almost all tyres on service cars in Bradford show this effect of the action of the shoe.

When the chilled portions of part chilled blocks are not uniform in volume or spacing of chill, the wear will be uneven.

While realizing the difficulty of producing uniform chills, it is, nevertheless, most important with this type of shoe that uniformity should be secured, and all shoes made from metal cast under conditions that will produce them with the same structure throughout.

Another example of unequal wear was that shown by shoe No. 8. This was first tested (Test No. 4) on its chilled face, and gave a frictional coefficient of 0·2044, with shoe wear 0·1649 lbs., and tyre wear 0·1549 lbs., the combined wear being 0·3198. After this test the chilled portion of the shoe was removed, and Test No. 57 made of the unchilled metal, and gave a coefficient of friction of 0·3498, shoe wear 2·41324 lbs., tyre wear 0·06226 lbs., a total combined wear of 2·4755 lbs. This shoe would, during the first portion of its life, have entirely different braking properties to those of its latter portion, the coefficient increase between the chilled and unchilled portion of the shoe being 71%. This variation in the coefficient of shoes during their life may be a source of danger.

Assuming that a pair of shoes fixed at one end of a four-wheel car have a greater depth of chill than those at the other, when the shoes become part worn, the shoes with the least depth of chill would be braking on soft metal, while the others would be braking on their chilled faces. This, by the great difference in their coefficient, would render it impossible for the motorman to obtain the full braking value from both pairs of wheels, the pair operated on by the unchilled shoes would be braked to the full extent of their adhesion on the rail, and skid, before the pair at the other end of the car had reached their full braking value.

Conclusions.

The conclusions arrived at by the author from the investigations described in this paper may be briefly summarized as follows:—

The durability and efficiency of a Cast Iron Brake Shoe is:

1st. A question of chemical composition.

2nd. The combination of its constituents and methods of founding.

From the cost point of view it matters little which suffers most wear—shoe or tyre.

If financial economy is the only consideration, the shoe that gives the least combined wear, per unit of cost, will be the one to adopt.

When it is desirable to economize energy for brake application and to reduce mechanical stresses on brake gear to a minimum, it is obviously best to use a shoe with a high coefficient of friction.

Given correct designs of brake-gear with ample stress margin and suitable method of power application, or its equivalent, financial economy can be made consistent with operative needs.

CONGRESS ON RADIOLOGY.

Brussels was the scene, from the 13th to 15th inst., of the International Congress on Radiology, when some important discussions took place and resolutions were passed.

Professor Rutherford, of Manchester, and Professor W. Duane, proposed that a grand committee should be constituted, charged with the detailed investigation of the choice and preparation of primary and secondary standards in connection with radium and the determination of the price of such standards. This was agreed to. Professor Rutherford pointed out that it was necessary that the international standard should be prepared by the aid of a pure substance, of which the atomic weight had been ascertained with complete accuracy. A certain quantity of pure radium (about two or three milligrammes) might be employed and hermetically sealed in a small tube. By means of the system of estimating the γ-rays, or by some equivalent method, there would be no difficulty in the standardisation of a number of secondarys standards, with a limit of error of less than 1 per cent. By this means it would become possible for the majority of laboratories to acquire a secondary standard containing a definite quantity of radium, which might serve to standardise further samples. Preparation of "Standard radium solution" for the determination of very small quantities of radium by the emanation method also to be undertaken.

After discussion it was resolved that Mme. Curie should prepare a standard of 20 milligrammes at the expenses of the International Commission on Radiology, this standard to be deposited at Paris in the laboratory of Mme. Curie. In accordance with this standard the Commission will then cause the secondary standards to be distributed to the affiliated laboratories. A standard measurement is to be created to fix the amount of the emanations, and will be known as the "millicurie" standard.

Two sets of apparatus were presented by Dr. Lenard, of Heidelberg. One was Professor Becker's "emanometer," designed to measure the emanations from liquids and solid bodies; the other instrument was a "decadometer," constructed by Mr. Remsauer at the Heidelberg Radiological Institute, for the purpose of making quantitative determinations of preparations of radium, thorium, and actinium. The former apparatus consists of an electrometric arrangement with a receiver in which the liquid of which it is desired to determine the emanation is agitated or shaken. The two portions are joined together by an indiarubber tube and an electric conductor. In order to measure the radio-active emanations by means of the emanometer the volume of air containing these emanations is made to traverse a cylindrical condenser, and the loss of charge which takes place during the passage through the condenser can then be determined automatically. The decadometer depends for its action upon the automatic comparison of the current of saturation it is required to measure with a current which traversed an air resistance at a definite tension.

Professor William Duane, who had experimented with five methods of demonstrating the energy of the radium rays, said he had ascertained that neither the bolometer, the radiometer, nor the thermo-electric pile furnished clear results, but positive results were obtained by means of the differential gas thermometer and a sensitive calorimeter.

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Mr. H. Geiger and Professor Rutherford explained that the number of α particles emitted by one gramme of uranium and of thorium had been obtained by the scintillation method. The number of α particles emitted by the minerals containing uranium was in fair accord with the calculated number.

Professor J. Joly, of Dublin, said that a trial made recently to obtain a direct measurement of the heat disengaged by the complete uranium-radium series (including also the actinium series) showed a value sensibly in excess of that calculated according to the relative energy of ionization of the members of the uranium-radium group.

M. Jean Becquerel, of Paris, explained that he had investigated in the case of solid bodies a phenomenon similar to that of the Zeeman effect. The fine bands in the case of certain substances (minerals and crystals, solid or dissolved salts containing the rare earths) sometimes underwent notable modifications in the intense magnetic field. These variations were likewise studied in connection with changes of temperature. The phenomena were observed at extremely low temperatures down to —259° C.

Messrs. Elster and Gettel, of Wolfenbüttel, who had reported some time ago certain properties of minerals, particularly in the case of blue or violet fluorspar, some kinds of barytine, celestine, aragonite, and felspar, which showed the Hallwachs effect even when the wave-lengths exceeded 400—that is to say, they emitted negative electrons in visible light, as did the alkaline minerals and alkaline earths. Mr. Gettel said he had now believed that it was possible to attribute this phenomenon to the fact that these minerals had been subjected to the radiations from radio-active substances during the time of their formation in the bowels of the earth, or subsequent to that period.

Before dispersing, the Congress appointed a permanent International Commission, constituted as follows:— Physics and chemistry, Mme. Curie, Messrs. Rutherford, Werschaffelt, Van Aubel, Righi, Wien, Exner, de Heen, Boltwoos, and Daniel; the Medical sciences, Messrs. Dean, Butchers, Bergonié, Lester Leonard, Lutwig, His and Bayet.

MORE ADVERTISING MATTER.

"Tantalum" lamp advertising has always been distinctive and effective, and contractors and the trade generally will find that this year Messrs. Siemens Brothers Dynamo Works Limited, Tyssen Street, Dalston, have arranged an even wider and more comprehensive scheme

than anything done in the past. They believe in enlisting the goodwill and assistance of the distributing trade. There are many special features which should particularly interest them, as affording facilities for promoting profitable business among their clientele. We reproduce here an illustration of the new design of "Tantalum" lamp show card, which is of a particularly attractive nature. It will be noticed that the design is one of the "Satisfied Consumer" series, and is a follow-on to the well-known poster, "My Electric Light Bill Halved." It is of small size, 12 in. by 9 in., printed in five colours, with the main features embossed, the lettering being glazed to make it stand out prominently. Posters of the same design, size 80 in. by 60 in. and also 120 in. by 80 in., are, we understand, supplied to any person who has a suitable space for displaying them about his premises.

The firm are also supplying a five-coloured card giving reduced facsimiles of all types of literature which they overprint in quantities with the contractor's name and address, free of charge. This includes postcards and three or four types of adhesive labels supplied for attaching to correspondence. We would particularly draw attention to the picture postcards. These are printed with the same design, and on the back the contractor's name and address can be overprinted, so that they may be used as correspondence cards. The adhesive labels are well known and widely used, and the latest production of the firm in this respect is a cut-out in the shape of a "Tantalum" lamp, which has been lithographed in colours, and on which the words "Use 'Tantalum' Lamps" appear. By fixing these to outward correspondence contractors can obtain an effective method of advertising "Tantalum" lamps. A reprint of the well-known Hassall design, the "Brilliant Passage" stamp, has been obtained, and these will be again supplied during the forthcoming season. A reprint has also been obtained of the Dalston Works adhesive labels, and these will also be supplied to all who desire to attach them to their correspondence.

With reference to Tube railway advertising, there is a very wide scheme arranged. Many people have noticed the present card in the trains which states "Watch this space for 'Tantalum' lamps," and there are thousands of people who are on the lookout for the design which is to appear in the space indicated.

Large posters are also appearing on the majority of the London tube and railway stations. We think that such an extensive scheme of railway advertising must necessarily reach many people who are actually using electricity as an illuminant.

In connection with poster advertising, Messrs. Siemens Brothers have arranged an extensive programme, and posters will appear on many hoardings in all the large provincial towns, whilst in and around London there will also be a representative display.

In conjunction with these large schemes of general advertising to the public, there are also several special schemes by means of which consumers will be approached direct. Although the sales of "Tantalum" lamps have been steadily increasing during the present year, yet under such a wide publicity campaign they must be still further increased. We would suggest that all contractors should take advantage of the generous offers of this very enterprising firm that they may each obtain their fair share of the business which must result. Any of these specialities can be obtained by writing to Messrs. Siemens Brothers Dynamo Works Limited, Tyssen-street, Dalston, London, N.E., who control and arrange the advertising for "Tantalum" lamps and fittings.

SLATE QUARRIES ELECTRIFIED.

We have from time to time given particulars of the use of electrification in the exploitation of quarries, chiefly on the Continent and in Scotland. A new development, its application to slate quarries, is now announced by the "Slate Trade Gazette," which describes an installation at the Ballachulish Slate Quarries, Ltd. This company have two direct current generators, one of 32 kw. and one of 27 kw. generating at 250 to 265 volts, belt driven by suction gas plant. The accessories include an electrically driven pump of the centrifugal type capable of delivering 140 gallons per minute against a head of 100 ft.; electric haulage gear on a gradient of 1 to 2 in places and with a capacity of two trucks taking 37½ cwts. each, the rate of transport being three miles an hour; an electrically driven hoist capable of lifting a single truck 80 ft.; and the necessary switchgear with reverse current and maximum overload devices and trip loose handles. The dynamos are interpolar compound wound machines, and the entire installation has been carried out by the British Electric Plant Company, of Alloa.

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Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

Terms for displayed advertisements may be had on application.

Second-hand Plant and Machinery Advertisements 24 words 1s. per insertion, three insertions for 2s. 6d., each additional line of eight words 4d.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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TRAMWAY ECONOMICS.

It was quite worth while holding the three days' Conference of the Municipal Tramways Association, at Bradford, if only as sober answer to those pessimists who hold that tramway extension on a large scale is now no longer possible. Of Mr. C. J. Spencer's presidential address we had something to say last week. He gave no uncertain note as to the possibility and necessity for considerable extensions, though he was careful not to depart from the orthodox view that a tramway line must not be constructed unless the population along its route, or, at least, at its terminus, was sufficient to supply traffic adequate to cover all expenses and leave a profit. Taking the total of the number of passengers carried last year over the 2,525 miles of tramways, it is found that the traffic carried was sixty times the estimated population, while in the cities and towns it generally averaged 150 times the number of inhabitants. It is usually argued that to justify considerable extensions that density of population should be able to give an estimated traffic of midway between these two figures. Mr. Spencer thinks that the first-named figure could be approximated to the second by developing traction facilities. He thought this could be done by adopting the trackless trolley system in sparsely populated districts, but specially looked forward to greater perfection of details. He thinks it is possible by still further improving car design and construction to economise some 50 per cent. of the current at present used, about 40 per cent. of which, he showed, was used up in wearing away brake shoes and tyres. In this connection the report of lubrication and the paper on brakes and tyres read before the Conference afford valuable confirmatory information, as our readers will agree. Mr. Spencer's concluding remarks are worthy of most careful consideration. He said that, technically considered, the modern electric tramway system is the result of a peculiar evolution of the methods of horse traction and railway practice. It would be well, he

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held, to ask ourselves how far our apparatus can be made to meet the strenuous conditions of modern service, and to then study closely the principles of the design of the appliances in daily use. He thought that by so doing we might find that in some cases we have been putting new wine into old bottles. Therefore, the immediate and pressing duty for the tramway technical man is to look closely into these matters and see what can be done to maintain tramway apparatus at the highest standard of efficiency and usefulness consistent with public safety and convenience. This is undoubtedly the right spirit in which to approach the problem of future extensions with a view to establishing an equilibrium, if not making profits. Alderman Flint, as becomes the chairman of a Tramways Committee, was emphatic on the obligation to earn profits. But he, too, was certain that extensions were both necessary and possible. He thought that wherever there is a desire for co-operation between adjacent towns it should be fostered and encouraged, especially when overtures were made by county authorities for joint action with the boroughs. Then, again, a means of putting tramways on a sounder financial basis was to relieve the undertakings from the onerous duties of maintaining the paved 18 inches outside the rails. Mr. A. Baker, general manager of the Birmingham Corporation Tramways, pointed a way out of the difficulty, at all events for those parts of the line immediately outside the main streets. He thought we ought to take a lesson from the Continent and endeavour to have wide thoroughfares, part of which would be set aside for the sole use of the trams. If this is done, ordinary macadam will suffice, or the rails may be laid on sleepers placed on the ground, and grass grown between the lines and on each side, paving only being resorted to at crossings. Of course, this means a very large saving, both as regards first cost of construction and then of maintenance. Other advantages are that the rails are not damaged by cross traffic of heavy wagons, and that an accelerated speed of travel can be kept up. As regards the provision of extra space, he does not consider this an insuperable difficulty. Where new districts are being opened up, especially under the Housing and Town Planning Act, highways at least 91 feet wide should be laid down. In other cases he thinks that landlords would give the necessary strip of land—6 feet wide—for the special tram "way." But if not, he argues, agriculture land near a town could be purchased for between £100 and £200. If we multiply 6 feet by 1,760 feet we obtain 10,000 square feet per mile. Even if £400 was paid for this there would still be a saving of something well over £3,500 per mile of tramway laid down and the cheaper methods of construction thus rendered feasible. Mr. Baker's vision of a special "way" for a double tram track, two footpaths, and two roads for ordinary traffic is alluring, and he thinks this is quite compatible with such cheap construction as would enable tramway extensions to be made into districts of light traffic, which under existing conditions cannot be contemplated. Thus Mr. Baker seeks to bring about extension by lowering initial outlay and cost of maintenance, and at the same time increasing facilities for transport. In this he agrees with Mr. Spencer, who, in addition to his desire to lower running charges, wishes to increase income. This he proposes to do by establishing "feeder" trackless cars, and by extending the use of the tram lines. He pertinently enough insisted that it was absurd to see the busy streets of cities obstructed by long lines of slow-moving, heavily loaded wagons, when the tramway afforded means for quick, easy and cheap transport of heavy goods. Bradford, indeed, during the last Session endeavoured to obtain powers to handle merchandise, but was refused the boon by Parliament on the ground that many other municipalities possessed the powers but did not use them. Leeds, however, is doing so, and has secured excellent contracts to handle heavy merchandise, to the benefit of the tramway undertaking's finances, and the relief of citizens, who secure less encumbered streets and better chance of profits from the trams. We see no reason why a new era of tramway construction should not soon be upon us.

FINANCIAL NOTES.

RANGOON ELECTRIC TRAMWAY AND SUPPLY.—The registered offices of the Rangoon Electric Tramway and Supply Company have been removed from Liverpool to Nos. 3 and 4, Great Winchester-street, E.C., and Mr. R. Lawrence Spicer has been appointed secretary to the company.

* * *

OKLAHOMA GAS AND ELECTRIC.—The directors of the Oklahoma Gas and Electric Company have declared a quarterly dividend of 2% on the Common stock.

* * *

MUSKOGEE GAS AND ELECTRIC.—The directors of the Muskogee Gas and Electric Company have declared a quarterly dividend of 1¾% on the Preferred stock.

* * *

SAN DIEGO GAS AND ELECTRIC.—The directors of the San Diego Consolidated Gas and Electric Company have declared a quarterly dividend of 1¾% on the Common stock.

* * *

MANILA ELECTRIC RAILROAD AND LIGHTING.—A dividend of 1% for the quarter ending September 30 has been declared on the total issue of $5,000,000 Common stock, and will be payable on October 1.

* * *

MELBOURNE TRAMWAY AND OMNIBUS.—The London secretary has received cable advice of the declaration of a dividend at the rate of 4½d. per share for the quarter ending 30th inst. (15% per annum), payable on October 1.

* * *

MADRAS ELECTRIC TRAMWAYS (1904).—An interim dividend of 4½% per annum on the preferred ordinary shares is announced.

* * *

KALGOORLIE ELECTRIC POWER & LIGHTING.—The directors of the Kalgoorlie Electric Power & Lighting Corporation, Ltd., have declared a dividend on the Preference shares at the rate of 6% per annum for the six months ending 30th inst.

* * *

EASTERN EXTENSION TELEGRAPH.—The directors of the Eastern Extension Australasia & China Telegraph Company have declared an interim dividend for the quarter ended June 30 last of 2s. 6d. per share, free of income-tax, payable on October 15.

* * *

ANGLO-ARGENTINE TRAMWAYS.—The directors declare an interim dividend of 3s. 6d. per share, less income-tax, being at the rate of 7% per annum, on the ordinary shares for the half-year ended June 30, 1910.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Some interesting improvements are now in progress of construction at the Carville power house of the Newcastle-upon-Tyne Electric Supply Company, Ltd., owing to the fact that this and associated companies are now supplying power as far as Blyth in the North and nearly as far as Middlesbrough in the South. From considerations of economy this has involved transmission at a high pressure. When Neptune Bank, Wallsend, was the chief generating station, the pressure on the trunks was 6,000 volts. Successive steps have been to 11,000 and then to 20,000 volts—the highest transmission pressure in this country. The generators at Carville still develop a 6,000 volt pressure which is converted in a sub-station at Carville to 20,000 volts. At this pressure it is carried through the company's recently constructed tunnel under the Tyne to Yarrow and then southwards partly by underground and partly by overhead cables. To meet the increased demand of the collieries in the Blyth district and also in the county of Durham an important extension has recently been made to the transforming plant at Carville. The existing sub-station has been duplicated, a new building being built by Messrs. J. W. Lowry, of Newcastle. It has two floors, in the lower of which are contained four 4,000 h.p. converters of the oil-cooled type, while on the upper floor is the switchgear for operating them. The converters receive the current generated by the turbo-generators in the adjoining engine room at a pressure of 5,750 volts and transform it to 20,000 volts, at which pressure the current leaves the sub-station. To reduce the heat of the oil a special arrangement of water cooling pipes has been installed, which has added over 2,000 h.p. to their capacity. The total capacity of the sub-station at Carville is now some 16,000 h.p.

A Large Haulage Gear.

In spite of the commercial depression existing owing to the general apprehension induced by labour troubles, and the effect of the eight hours' Act upon colliery activity, the forward movement in the installation of electricity in collieries is practically unchecked, every week giving further instances of the use of electrical plant for mining work. One of the latest and most important examples is an order which has been received by Messrs. Ernest Scott & Mountain, Ltd., of Gateshead, from the South Hetton Colliery. This is for a large haulage gear to operate at 3,000 volts terminal pressure on a three-phase supply without any intermediate transformer. As the haulage is of 500 b.h.p., it will be seen that this will prove to be an exceptionally interesting plant from an electrical as well as a mining point of view.

Electrical Timekeeping in a North Shields School.

A very interesting system of time-keeping and bell-ringing by means of electricity has just been introduced at the Secondary School, North Shields. There are in all eight clocks in the various rooms, under which are placed electric bells. The clocks are driven by a transmitter, the chief feature being that all clocks keep uniform time and do not need winding, ordinary Leclanché cells being used to operate the system. In the bell-ringing system contacts are fitted in the clocks so that all the 12 bells ring automatically at predetermined times. During the week-ends and holidays the bells are cut out of action by a two-way switch, but this does not affect the working of the clocks. In the headmaster's room is a push by means of which he can, while seated at his table, ring all the bells at once and clear the whole school in a few seconds in case of fire or other alarm. The installation was designed and carried out by Messrs. Gent & Company, Ltd., of Leicester and Newcastle.

Rutherford College.

One of Newcastle's technical institutions, the Rutherford College, has recently undergone extension and improvement, and on the 22nd inst. the new technical buildings were formally opened by Professor Sadler, of Manchester. The new structure is two storeys in elevation and is so designed that further increases can be obtained by building further storeys on the present flat roof. In the new wing are situated the electrical, physical and engineering laboratories, together with some class-rooms.

Sir Andrew Noble.

In commemoration of the Jubilee of the connection of Sir Andrew Noble with the Tyneside undertaking of Messrs. Sir W. G. Armstrong Whitworth & Company, Ltd., the honorary freedom of the city of Newcastle-upon-Tyne was last week conferred upon him. Sir Andrew has rendered great service to science by his researches in ballistics, and has been largely instrumental in increasing the works from an undertaking covering less than 20 acres to over five times that amount. The number of men employed has increased fifteen to eighteenfold in the 50 years of his connection. As the works include such an important electrical department the event is of considerable interest to all electrical men.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The members of the Warwickshire and South Staffordshire Branch of the Association of Mining Electrical Engineers had a pleasant surprise on Saturday last in the presence at the first meeting of their new session of the President of the Association, Mr. W. Maurice. The agenda included the discussion of Mr. W. Foster's paper presented last session on "The Resistance of the Human Body to Electrical Currents," but the discussion was postponed. Mr. J. R. English, however, had prepared a curve based upon Mr. Foster's figures with some comments upon it, and this was handed in for consideration in conjunction with the paper. Mr. English said it was rather remarkable that with an average person the pressure, if steadily applied, might be increased to 5,000 volts. The resistance of the body decreasing as the pressure increased, so that about 200 amperes might be sustained.

Aims of the Association.

Mr. Maurice's visit was unpremeditated, and his address was more or less impromptu. He said that although the Association had only been fully constituted about nine months, there had already been a considerable increase in membership, and during the present year three new branches had been formed, namely, at Whitehaven, at Glasgow, and at Dunfermline. Six members of the Council of the Whitehaven branch had received the Albert Medal for heroism in connection with the Whitehaven Colliery disaster, and the branch had the strong support of practically all the colliery managers in the neighbourhood. He would like to see more members joining the branches, and also to see a large addition to the number of associates. They did not derive any financial advantage from the associates, because they gave them a very great deal for their money, but the object of the Association was to educate everybody connected with mining in the use of electricity in mines.

General Knowledge of Electricity Necessary.

The purely mining men, Mr. Maurice pointed out, the under-managers, deputies, and other members of the underground staff, had quite as much interest in acquiring

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electrical knowledge as those who were immediately responsible for the electrical plant. The deputies and other underground officials were bound to report anything wrong with the electrical plant due to falls or other mishaps, and it was very desirable that they should be able to recognise any defect so that they might be able to prevent accidents, and promptly report the matter to the electrical expert. He regretted that English working people on the whole were little given to self-improvement. When in Germany recently he was very much struck with the amount of inconvenience a German workman would endure in order to acquire more technical knowledge and fit himself for a better position. The English workman, as a rule, was too apt to be content with his position, or to think that possibly he could get a better position with a bit of luck, and, perhaps, not very much in the way of qualifications. Still, when it came to stern practical problems, our own countrymen often came out on top. Technical training when overdone might produce a man who lost his head in a maze of technicalities when he ought to be taking off his coat and turning up his sleeves. They must keep the middle way, preserving the strong practical character of their men and doing their best to induce them to take an interest in the technical side of their work, and there was no other institution in the country which offered similar advantages to those which their Association offered to men connected with collieries.

Spread of Electricity.

There were few collieries now, Mr. Maurice said, without some electrical plant, and the tendency was to work everything by electrical means. Therefore, absolutely everybody connected with colliery work ought to have a certain amount of electrical knowledge. That was not going to do harm to the qualified electrician. A colliery could not work its plant electrically without the aid of thoroughly qualified technical men. Those who had been trained in other departments of the work should not study the subject with the object of managing electrical plants, but they should have some knowledge of electricity in order to be able to contribute to the general safety. No plant, however, could be kept in proper order unless it was under the charge of a man who had been specially trained for that work.

Examination for Members.

Among other interesting topics mentioned by Mr. Maurice was the intention of the Council shortly to establish examinations for members. These would be conducted, he said, by persons entirely independent of the Association, and the character of the examinations would be such that their certificates would command the respect of the mining community. The registration of the Association was on the point of completion and the statutory meeting necessary in connection with this would probably be held before Christmas. The annual general meeting would take place at Newcastle-on-Tyne on October 7 and 8, and the Tyne Commissioners had granted the Association the free use of a boat to take the members up the Tyne to visit the Harbour power station, which, he believed, was the largest in the world, certainly the largest in Great Britain, and also to the Harton Colliery, where all the work was conducted electrically. The President also described an arrangement by which all papers considered worthy to appear in the annual transactions would be printed and sent down to the branches for simultaneous discussion. Papers of less importance, but of practical interest, would be relegated to the branches from which they originated, and in order to provide against the possible dearth of papers the Council from time to time would send out questions of a practical character which could be discussed without the formality of a paper. By this scheme it was hoped to forestall the difficulty experienced by so many technical associations in finding work for the branches.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

At an engineer's meeting here Drs. Hoffmann and Bochum gave an account of the application of electric power in ironworks, of which the following is an abstract. It seems that during 1909 the large German concerns did well in spite of lower market prices for their products. As has so often happened this apparent drawback was a blessing in disguise. It compelled the owners of these works to utilise the blast furnace waste gas to its fullest extent for power purposes, and to seek out and find the cheapest ways of obtaining the power required to work their plant. It is with this second point that we have chiefly to deal. The urgent necessities just mentioned have caused steam engines to be replaced to a large extent by electro-motors and gas engines. As regards the use of gas-engines German ironworks stand first, with the United States as a rather bad second. The Korting gas engine has been almost universally adopted for blowing the blast furnaces, and some are now in use which develop as much at 1,500 h.p. per cylinder. One at least is in existence giving 2,000 h.p. per cylinder. In rolling mills, motors worked with a rotary current are being introduced more and more, especially in the case of non-reversing rolls. Even with reversing rolls, electric motors are now beginning to compete successfully with steam engines when very high powers, say 15,000 h.p. and upwards are required. Here the rotary current motor has many advantages.

Electric Furnaces.

As a resistance for heating crucibles up to 1,500°C. Hempel, of Dresden, has recently tried silundum (silicified carbon) instead of ordinary carbon. By the means of the silundum rods, a temperature of 1,400°C. is reached in a quarter of an hour with a 20 ampere current at 110 volts. Silundum cannot be used for temperatures above 1,700°C., as it then begins to evolve silicon vapours. For the highest temperatures, say 2,000° and upwards, carbon poles are the only possible ones, and they must be tightly packed in carbon dust to preserve them from chemical action. Hempel has also used silundum for the walls of small furnaces.

Blast Furnace Gas for Electric Power.

The long distance Lubeck station, built by the Berlin Siemens Company, and which relies for power on the blast furnace gases not required by the ironworks, has enormously extended the scope of its operations, and will shortly supply almost the whole of Holsteain, including Lubeck and Oldenburg, to say nothing of a large part of Mecklenburg. Four cables will carry a 30,000 volt current over a radius of 50 miles. Lubeck itself will take annually 1,750,000 kw. hours, and the Oxyhydric G.m.b.H., has started to build a factory near the power station which will use double that amount. Even Wisman has made a contract for power with the station, and a company is being formed in Oldenburg to do the same thing. Other negotiations are in progress.

Long Distance Stations.

Quite a dozen projects for a station at Hannover Munden have been started, and now there is yet another, for the Gewerkschaft Steinberg, which owns large brown coal mines intends to erect such a place. Their proposals have been very generally approved, and negotiations which will probably lead to the realisation of the project have been begun with the Gottingen people. At Munsingen the Laichingen Gas und Elektrizitatswerk are erecting an electric long distance station with the consent of the Government. So far the following places have identified themselves with the project for their supply of electric light and power. Nellingen, Merkungen, Machtolsheim, Suppingen, Obeaant Blaubeuren, Sontheim Ennabeuren, Feldstetten, Obenamt Munsingen, Obeaamt Geislingen, and Westerheim.

New Electric Railway.

The Frankfort-Heddernheim line has been extended into the famous Taunus district. The power is derived from a continuous current of 1,000 volts and the trams run at 25 m.p.h. Each carriage accommodates 24 seated passengers and 18 strap-hangers, and weighs between 15 and 16 tons. The electrical part of it weighs 5 tons. The motion is controlled by a compressed air brake and matters are so arranged that it is impossible to put on this brake without throwing the electric motor out of gear. A mechanical brake is also provided.

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Company Notices.

The Deutsche Kabelwerke A. G. Berlin Kummelsburg has decided to increase its capital from 3½ million to 5¼ million marks. The new stock will bear interest from January 1, 1911, and is taken over at 15½% premium by the Dresden Bank of Berlin, and issued at 25% premium with preference to present shareholders.

The Breslau electric trams made a gross profit for 1909 of 3,417,223 marks as against 3,271,625 in 1908. The net profit is 919,019 marks (843,012 in 1908). The municipality takes 471,638 marks, and 422,500 marks go to pay a 6½% dividend. The carry over for 1910 is 10,588 marks.

The Brunswick-street trams have been quite as prosperous. At the general meeting the dividend was fixed at 6%, both on the old capital of 4½ million marks, and on the new capital of 1½ millions created in 1909. The holders of the latter get only half a year's dividend, however. The net profit was 338,107 marks, and the carry over is 6,120 marks.

Lighting Railway Carriages.

A movement is on foot to secure that the railway carriages on Austrian State lines should be lighted by electricity only, and the idea seems likely to succeed, for 110 new coaches which are to be put in use next year are to be electrically lighted. The system chosen is the mixed one, where the current is got partly from a dynamo driven by the motion of the train and partly from a secondary battery. Each compartment of every one of the new coaches is to have two 20-c.p. metallic filament lamps. At present, however, it would not pay to light the existing coaches with electric light on account of construction difficulties, but there is no doubt that non-electric lights will disappear as the old passenger rolling stock is scrapped.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Mention was recently made in these notes of the satisfactory results which followed upon the introduction of electricity in the mines of the Woodward Iron Company in Alabama. A report on the operation of the electrical haulage, ventilating and pumping plant which has been published this week gives some further details of a very interesting character. The output of the two mines concerned is 1,000 tons per day each. The central power station is located at the furnaces and the steam is furnished from the furnace boilers generated by waste gases from the furnaces. Alternating current of 3,300 volts, three-phase, 125 cycles is generated and transmitted nearly 3 miles. For supplying the direct current to the electric locomotives, rather an innovation was introduced in the location of the substations. It was not feasible to locate the station outside, owing to the distance necessary to transmit the current, the loss and high copper cost. It was not considered desirable to locate the station above the workings and drop the line through a bored hole, because the station would have been located about 2½ miles from the railroad and in such rough country that it would have been very difficult to reach to make necessary repairs. It was, therefore, determined to shoot out a chamber in each mine and place the rotary converters underground. The 3,000 volt current is taken down the slopes in a three-conductor cable, thoroughly insulated and steel armoured, and suspended from the roof out of reach of cars and men. In addition to these cable feeds, there is an overground line running to the fan shaft and then down to the converters. Thus there is a loop supply which will run the mines in case a fall of rock should disable the cable, or a storm cripple the outside line. In one mine there are four 6-ton locomotives and one 8-ton slope motor; and in the other, four sixes and a 10-ton. Any four of these will keep up the output. It is possible for the slope motors to pull their full tonnage and maintain when necessary a speed of 25 to 30 miles per hour. Thus it is now possible to handle 60 % more coal with 10 locomotives, 10 motormen and 10 switchmen, than was possible with 70 mules and a host of drivers.

Advantages of Electricity.

Electricity has also been applied to the drainage of the mines, some 2,500 acres of worked out territory having to be operated. A number of small geared pumps are used, says Mr. Morris Bush, the Woodward Company's engineer, and these throw the local drainage to a central pumping station consisting of two triplex geared pumps of a capacity of 750 gal. each per min., discharging through 4,000 ft. of 14 in. main against a vertical head of 635 ft. Then, again, the ventilating problem has been wonderfully simplified by the introduction of electricity. Instead of the old paddle-wheel fan, of slow speed which took occasion periodically to shed some of its arms, it is now possible to use the compact high-speed fan, mounted directly on the motor shaft. Another great convenience in having electricity is the possibility of introducing the electric coal cutters. It is found that the coal cutters are of immense advantage, particularly where the coal has any partings that would be shot up and mixed with the coal. It is proposed to use behind the machines a small electric drill and hydraulic cartridges, thus doing away with explosives in a large part of the mines. As to minor advantages of electricity, it is the work of only a few minutes with a portable pump to unwater any local sag that may give trouble. It is of immense advantage in preventing accidents and delays to have all concentrating yards thoroughly lighted and all main turn-out switches to show automatically whether the switch is open or closed. There is also the convenience of doing away with the expensive and troublesome storage batteries for signals and instead tap the main transmission line with a low-voltage bell-ringing transformer. Frequently, also, it is of considerable advantage to use in a long, tight heading a small, self-contained portable fan. These can be carried around on a truck and set off at any desired point.

New Induction Regulator.

The Westinghouse Company of Pittsburg is just putting on the market a motor-operated single-phase induction regulator which embodies some important new features tending to ensure greater efficiency and longer life. A skeleton frame construction permits the use of a "cast-in" corrugated sheet-metal tank which affords a larger and more efficient radiating surface than the cast-iron tanks used with the earlier regulators, thereby insuring a low operating temperature. This type of tank is also less liable to give trouble from oil leakage, which sometimes occurs with the cast-iron tanks on account of unavoidable defects in the castings. In the latter, the leaks usually developed after the punchings and windings had been placed in position, thus causing considerable loss of labour in the work of rectification, while in the case of the "cast-in" tank a defective tank entails no other loss than the tank itself. In the earlier designs the cast-iron tank was bored out to receive the stator punchings. As this tank was open only at the top, difficulty was sometimes experienced in obtaining an inner cylindrical surface which would be in perfect alinement with the rotor bearings located in the cover and bottom of the tank. Up to and including the 95 kw. size, the polyphase regulators have "cast-in" corrugated sheet-metal tanks. They are similar to and possess all the advantages of the "cast-in" type of tank. They possess great strength mechanically, have large radiating surfaces and dirt and dust-proof qualities. An oil gauge at the top and a valve as oil drain at the bottom are provided. The regulator is shipped assembled in its case. Above 95 kw. the regulators are usually oil-insulated and water-cooled. Boiler-iron cases with cast-iron bases and covers are usually used. The single-phase regulator has a tendency to vibrate, but this has been overcome in the Westinghouse regulator by careful design of the bearings and shaft. The moving element is carefully centred so that a uniform air gap is secured, and the tendency to vibrate is reduced, owing to the low point on the saturation curve at which the magnetic circuit of the regulator is worked.

Motor Elevator Control.

The Westinghouse Company is also placing on the market a new form of alternating current elevator motor controller, which seems to fulfil all the requirements of a thoroughly effective controller while eliminating all those complications

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which have hitherto been a source of expense as well as of uncertainty of action. This has been brought about by the adoption of a very simple but ingenious piece of mechanism. The controller consists of a slate panel on which are mounted two rows of switches and their operating mechanism. The switches of the upper row serve to connect the motor primary with the line, and those of the lower row short-circuit the resistance in series with the motor secondary. All switches are alike and interchangeable. Five primary switches are used for a three-phase controller and six for a two-phase controller. The switches are opened and closed by cams. In closing, each cam acts on its own switch through a buffer spring which serves as a cushion and also compensates for wear; in opening, a lug on the cam engages a projection on the switch arm and forces the switch open. The resisters for the motor secondary are mounted on the rear of the panel. The movement of a hand rope or lever in the elevator car operates a sprocket attached to the primary cam shaft. A turn of the cam shaft from the off-position closes a set of primary switches and starts the motor so that the elevator car moves up or down, according to the way the shaft is turned. The movement of the cam shaft simultaneously releases a catch and allows a weight, attached to an arm geared to the secondary cam shaft, to fall; the arm rotates the secondary cam shaft and closes the secondary switches in proper order. The fall of the weight is retarded by an air dash-pot, the piston speed of which can be so adjusted by means of a valve that proper acceleration can be given to the motor. Turning the cam shaft from the off-position in the opposite direction closes another set of primary switches and reverses the direction of rotation of the motor; the secondary switches always close in the same order. On turning the controller to the off-position, the secondary switches are opened, the weight is raised and set ready for the next operation, and the primary switches are opened, thus completely disconnecting the motor from the line and stops it. The off-position is plainly indicated to the operator by a notch. Positive stops prevent over-running beyond the full speed positions. The operator has complete control over the starting and stopping of the motor, while the acceleration is performed automatically at a rate that can be adjusted over a wide range at the controller but cannot be altered by any action of the operator in the car. Any part of the controller is accessible from the front and all the parts subject to wear can be readily replaced. The electric contacts are of the quick-break, butt type and are protected by arc shields; there are no sliding contacts. All automatic operations are performed by the force of gravity. The controller is made for use in connection with two and three-phase alternating current slip-ring induction motors of 30 h.p. and less, for all voltages under 550, and for all commercial frequencies.

Water Power Potentialities.

A pamphlet prepared by the Water Supply Commission of the State of New York gives a remarkable account of the magnitude of the undeveloped power resources of this section of the Union. The pamphlet has been prepared for distribution in connection with the exhibit to be made by the Commission at the State fair in Syracuse. The Commission strongly urges the enactment of legislation which will make possible the development by the State of those resources on reasonable terms. The Commission says: "Water-power privileges of great value, amounting to 200,000 h.p. at Niagara Falls alone, were given away to private interests before the State awoke to the need for adopting a wiser policy. This thoughtless alienation of the public right has been abandoned and the most recent grant of water-power rights contained conditions providing for definite fixed payments to the State for the privileges conferred. For the development of its resources of its water-power, it is proposed that the State shall authorise the issue of bonds to the amount of $20,000,000, every dollar of which, with interest, is to be repaid from the proceeds of the sale of the power produced. And when the work has been completed and paid for, it is estimated that the development will yield a large permanent income to the State. Although greatly distressed for lack of water for power, which can be furnished to them only by the State, the water-power users, many of whom for years have enjoyed special privileges at public expense, have hitherto been unwilling to meet the terms proposed by the State. They have been able in the Legislature to prevent the submission of the plan to the people. This opposition has prevented the adoption of a reasonable plan of water-power development in the public interest; but that it can long continue to block progress in this direction, when once the situation is fully understood, is not believed to be possible."

Electric Cooking and Heating.

In a noteworthy article on building up the central station load the "Electrical World" asks how long it will be before central stations in general will make a determined effort to bring electric cooking and heating into real popularity, and diagnoses the chief difficulty as that of making a suitable rate for meeting the peculiar exigencies of the case. On the face of things a heating and cooking load is undesirable on account of the relatively large demand and modest total consumption. But the unconsidered advantages in the case are the time of the demand, and the effect of the diversity factor. The general experience of those companies making a drive for such business is that the load thus acquired is very largely off the peak, so that the effect of the relatively large demand may be almost ignored. Take, for example, the case of the minor household appliances like flatirons, coffee urns, vacuum cleaners and so forth. These are almost universally used during daylight hours when the lighting is not on in any amount, and the lines and stations are lightly loaded. They do not even materially affect the house wiring or the house transformer capacity, since in nearly every instance the current required is less than that allowable for the smallest wire permitted by the Underwriters' rules, and the appliances are not in use when the transformer is carrying any lighting. In the more important but less common case of electric kitchens and luminous or other radiators, the conditions are also favourable. Cooking proceeds actively only at times when the lighting load is small or on the wane. Two meals of the three are prepared at times of almost no lighting, and the evening one comes on after the cessation of the day's activities has lessened the load in shops and offices. Its general effect would be to produce a somewhat more gradual tapering off of the evening peak than is ordinarily found, which from the operating standpoint is certainly no disadvantage. There is, too, a considerable variation likely in the time of using ranges and radiators, the effect of which is still further to spread out the load and lessen the aggregate effect of the individual demands. Load of this kind is therefore rather desirable than otherwise, and if it can be secured in any considerable amount, is a very considerable addition to the income derived from the plant.

British Columbia Electric Railway.—The directors of the British Columbia Electric Railway Company are about to offer to the holders of the 4½% Vancouver Power Debentures the right to exchange each £100 Vancouver Debenture for £102½ of the company's 4½% Perpetual Consolidated Debenture stock and a cash payment of £1 in respect of interest, fractions of £1 to be paid in cash. It is pointed out that, as the present market price of the 4½% Debenture stock is 103½ ex interest, with a free market in the stock, and that, as the present price of the Vancouver Power Debentures is 101½, with only a restricted market, this offer is equal to a premium of 5½% on the amount of the debentures held by them. The directors reserve the right to withdraw the offer at any date after November 1 next. In order that the new Debenture stock may rank pari passu in all respects with that already issued and quoted and be good delivery on the Stock Exchange, the Debenture stock to be issued in exchange will carry the full half-year's interest from the 30th inst. to March 31 next, and a cash payment of £1 per £100 debenture will be made in respect of interest on the Vancouver Power Debentures from July 15 to the 30th inst.

Madras Electric Tramways.—The directors of the Madras Electric Tramways (1904), Ltd., have declared an interim dividend of 4½% per annum (2s. 3d. per share), less income tax, on the Preferred Ordinary shares for the half-year.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

CHADDERTON.—The Oldham Corporation have applied for the consent of the District Council, under Section 559 of the Oldham Corporation Act, 1909, to supply electricity to intending consumers within the urban district. The question stands adjourned for a month, although it was intimated that sanction would be given, provided the Corporation undertook to withdraw and sell their mains should the Council decide to undertake electric supply themselves. Meanwhile the Council will consider whether they should undertake the generation of electricity, purchase current in bulk from Oldham and distribute it, or come to terms with the Corporation on the lines above suggested.

CHELMSFORD.—The Education Committee have decided to have the Trinity-road Schools lighted by electricity. Tenders have been called for both gas and electricity, and although the tender of the Chelmsford Gas Light & Coke Company was the lowest (at £105), that of the Electrical & Motor Company, of Banbury (at £174), was accepted.

DARTFORD.—The Council, who propose to extend their works, have done well out of electricity. Mr. J. D. Pember may be congratulated on the results of the past year's working. The income was £9,098, an increase of £868, and the gross profit £4,053, while the net profit was £628, an increase of £571. This is largely due to good management, the total working expenses showing a decrease of 19½ per cent. in the cost of units sold. There has been a decrease in the consumption of current on the tramcars, which are now fitted with Chamberlain and Hookham meters.

DUBLIN.—The Lighting Committee have been instructed to prepare estimates for the electric lighting of the New Kilmainham Ward.

EDINBURGH.—On the suggestion of the Lord Provost, a recommendation by the Electric Lighting Committee as to the disposal of the surplus on the electric lighting accounts for the past year, and the surplus of interest, after bringing the reserve fund up to its maximum, to the effect that the surplus of £7,300 be applied towards the reduction of the capital moneys borrowed for electricity purposes, was taken back for reconsideration. Mr. Stevenson maintained he had precedence for the proposed course, but the Lord Provost held there was no parallel with this and any previous case.

ERITH.—A cable is to be laid at an estimated cost of £54 to supply consumers in Raglan, Nelson, Havelock, Wellington and Napier-roads. The following tenders of Messrs. Fraser and Chalmers, Ltd., for the supply of the undermentioned spare parts of plant were accepted, and the Clerk was authorised to include the same in the application to the Local Government Board for borrowing powers, viz.: Motors for condenser pumps, £82 10s.; pulverizer rotor, £28; rotor for pulverizer motor, £15.

GRIMSBY.—Reporting on the new street lighting scheme, Mr. Vignoles, the electrical engineer, said that the first 36 street lamps were in use on September 9, and a further 30 on the 16th. About 200 posts were erected and the fittings delivered, so he hoped to get them into use at the rate of 25 to 30 per week, this being the rate at which the connections could be made. He further reported that the Accumulator Industries, Ltd., whose tender for lamps was accepted on a sample of 50 being satisfactory, now asked to be excused from carrying out the contract. The committee agreed to this on the advice of the Chairman, and they placed the contract with Cryselco, Ltd., of Bedford, whose price for lamps of a guaranteed life of 1,000 hours was £15 per gross. The committee are charging the Corporation the same sum as was paid to the Gas Company, and expect to make a profit.

KIRKCALDY.—The Road Committee of Kirkcaldy District Committee have had under consideration a letter from the Fife Electric Power Company, intimating their intention to erect an electric power cable from Lochgelly to Newton of Wemyss. The Road Surveyor pointed out that the proposal of the Company was to construct six lines of bare copper wire on wooden poles. The wires would pass over six highways within the district. It was resolved to recommend the District Committee that the electric cables, so far as across or alongside roads, should be placed underground.

LEICESTER.—The Gas and Electric Committee report that the accounts of the electric lighting undertaking for the half-year show a profit after paying interest on capital and £3,343 16s. 10d. on account of Sinking Fund, of £635 3s. 6d. They have decided not to appeal against the injunction granted against the Corporation in the proceedings instituted by the Attorney-General, at the instance of Mr. C. J. Utley, of Leicester, electrical engineer, for an injunction to restrain them from carrying on the electric wiring and fittings department.

LLANELLY.—The Council having had a letter from the Llanelly and District Electrical Light and Traction Company, agreeing to contribute £250 towards the fees of Mr. J. C. Howell, whom the company and Council had tentatively agreed to appoint as electrical expert in connection with the electrical light and traction scheme, decided upon the appointment. Mr. Howell, who attended the meeting, in answer to questions, said that the £250 would cover his services up till the completion of the generating station now in course of construction, the laying and connecting of the cables; and also his services rendered to the Council in negotiations since 1908.

LONDON.—The Metropolitan Electric Supply Company are raising the price of current for lifting purposes to private consumers from 5½d. to 6d. per unit, but subject to a reduction to 4d. per unit for all units used above the quantity formerly taken by such consumer.

MAIDSTONE.—The Electricity Committee have decided to lay a cable in Hastings-road, at an estimated cost of £167 10s. Also that 50 current limiters be purchased at 17s. 6d. each.

NEWPORT.—Some correspondence has been received from the Local Government Board regarding the proposal to raise £31,255 for electricity extension work, and about which a public inquiry has been held. It is proposed to send a deputation from the Electricity Committee to confer with the authorities in London.

OLDHAM.—Mr. Newington, the Corporation Electrical Engineer, reported that since the alterations to the boiler furnaces, combustion had been greatly improved, very little smoke being produced, even when the worst possible coal was used.

SOUTHEND-ON-SEA.—A letter was submitted from the Secretary of the Local Government Board referring to the application of the Corporation for the sanction to the borrowing of a loan for the provision of battery storage rooms at Chalkwell and Thorpe Hall Estate, together with the necessary mains and services, and enclosing their sanction to loans of £4,022 for mains and £4,000 for services, and stating that with regard to the suggested battery storage rooms, whilst they considered the proposals were generally satisfactory they had deferred issuing their formal sanction to a loan for these works until tenders therefor had been obtained and amended estimates based upon such tenders submitted to the Board. The Electrical Engineer reported that he had obtained tenders for the plant that would be required for the battery storage rooms, and he was authorised to open and tabulate the same and submit them to the Committee at their next meeting, and the Borough Surveyor was instructed to obtain and submit tenders for the erection of the necessary buildings. At the request of the Leigh Urban District Council, the Borough are applying for a Board of Trade order to permit them to supply electricity to a cinematograph theatre at Westcliff.

ST. JUST.—The Penzance Electric Light Supply Company are about to bring a cable to Botallack, and hopes are held out that St. Just may be lighted by electricity.

ST. PETER'S.—The Newcastle Electric Supply Company have extended their sub-station here in order to meet the increased demand for power at Messrs. Hawthorn Leslie's Engineering Works. There are now three transformer chambers, 29 feet by 21 feet by 14 feet high. In this sub-station the pressure is reduced from 5,500 volts, at which it is received from the generating station, to a pressure of 440 volts, at which it is used in the works. The total capacity of the sub-station is now 2,000 h.p., there being three 700 h.p. transformers, oil cooled. The high tension switchgear is the same as before, being of the Brown-Boveri "Grid" type supplied by Messrs. Richardsons, Westgarth. It consists of two feeder panels, each of 2,500 kw. rated capacity at 5,500 volts, and three transformer panels, each of 1,000 kw. rated capacity, while one extension is allowed for. The low tension switchgear is of the Reyrolle ironclad type with three transformer panels, and each of 1,000 kw., at a voltage of 440. There is also a small 30 volt battery used for the tripping switches on the protective gear.

SUNDERLAND.—The half-yearly estimates for the Corporation Electricity Works show an increase of £209, which is the amount put down for the conversion of the gas lamps into electric lamps.

OVERSEAS.

BULAWAYO.—The Bulawayo Waterworks Company has just arranged a contract with Messrs. Stenmark and Vaaler, electrical engineers, for the reconstruction and putting into efficient condition the whole of the lighting system for Bulawayo. Nearly 200 street lamps of a new and improved pattern, greatly minimising the chances of a breakdown, will replace the old pattern. Three new transformers will be installed to automatically regulate the pressure on the three street circuits. A new type of lightning arrestor will be erected at 52 different points on the

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lines to protect the system from damage during storms. Connecting links will be introduced into two town lighting circuits, so that in the event of a breakdown on one line the lights can be switched on to the other. The work will be completed in about six months.

CAWNPORE.—The Indian Electric Supply and Traction Company are elaborating a scheme for the supply of fans, motors, lamps and even wiring on the hire system, in order to encourage the demand for current.

CONSTANTINOPLE.—The Minister of Public Works has given the contract for the electric lighting of the capital for a period of 50 years to a group of French and Hungarians, represented by the Elecktricitats Gesellschaft Ganz & Company, of Budapest.

MEXICO.—The Government have entered into a contract with Senor Joaquin Garcia Pimentel, representing Senor Luis Pimentel, for the use for irrigation purposes of water from the Barranca de Santos, in the States of Puebla and Morelos. The concessionaire is authorised to take not more than 500 litres per second in the dry season, and 2,000 litres per second in the rainy season. He may set up telegraph and telephone lines on the works for his own private use. Work must be begun within two years from the date of publication of the contract, and be completed within seven years from that time. Machinery, etc., for the work may be imported, once only, free of duty.

SAN JOSE, COSTA RICA.—The Government have signed a contract with a British subject for the establishment and working of a submarine cable between Colon and Limon. The concessionaire is given the exclusive right for 15 years of working a cable office in the Republic, and during that time he may import free of duty all materials, instruments, and supplies required for use in his enterprise. He is also granted the right to establish in the Republic one wireless telegraph station for the furtherance of his work in the cable station. Work must be begun on the installation of the cable within nine months from the date of legislative approval of the contract, and must be completed within 18 months.

UITENHAGE, CAPE COLONY.—The electric light scheme, which has been carried out by the General Electric Company, London, is now in full working order and is giving complete satisfaction.

TRACTION.

HOME.

BELFAST.—A further step in the tramway extension scheme has been taken, the Council having decided to accept Mr. A. Nance's recommendation to construct the line to M'Art's Fort on Cave Hill.

COVENTRY.—A strong feeling is being manifested that the Corporation should take over the tramways when the company's lease expires, which will happen shortly.

HANDSWORTH.—At a meeting of the Handsworth Council, the Chairman, in introducing the Tramways Committee's report, said that as a result of the arbitrator's award the Council was to receive a rent of £5,500 a year for the depots and cable tramways in the district. Payment had already been made of a sum of £4,700. He thought the outlook for the tramways was very good, and so far as he could see there need be no charge made on tramway account during the present financial year.

KEIGHLEY.—The Council have decided to promote a Bill next Session giving powers to place trackless trolley cars along certain routes.

MANCHESTER.—The Trafford Park Estates, Ltd., made a profit of £684 on the electric tramway, after charging for depreciation, during the year ended June 30.

ROCHDALE.—The Tramways Committee have been approached to push forward the construction of the extension from Firgrove to Newhay, but it seems unlikely that the work will be taken in hand this year.

SOUTHEND-ON-SEA.—The Borough are about to make a trial with meters on their tramcars. The Council is being urged to extend the light railway to Hadleigh, but this question has been postponed until a comprehensive scheme for the whole system is considered at a special meeting to be held shortly.

WATFORD.—The Tradesmen's Association have threatened to use strenuous opposition to the adoption of the trackless trolley system by the Urban Council.

OVERSEAS.

BUENOS AIRES.—Negotiations are going forward for the electrification of the tramways at Mar del Plata, and it is expected that a contract will soon be signed with Messrs. Agar, Cross & Company, representatives of the British Westinghouse Company.

RANGOON.—The Government have granted a provisional concession for the construction of 17 miles of tramway in the Akyab district by the Arracan Flotilla Company, Limited, of London and Burma. The concessionaires will be known as "Maungdaw Buthendaw Railway Company."

ROME.—The Ministry of Public Works have (1) approved the plans for the construction and working by the "Società Italiana per le Strade Ferrate del Mediterraneo" of a railway from Umbertide to Terni, *via* Todi; (2) granted the application for a concession for the construction and working of an electric railway from Argegno to Lanzo d'Intelvi; (3) reported favourably on the proposal to link up the Iseo-Rovato Railway with the Milan-Venice line, and on the application lodged by the "Società Edison" for the construction of an electric tramway from Affori to Varedo, this being an extension of the Milan-Affori tramway.

SALTA, ARGENTINA.—The electric light station in Salta, which belonged to Mr. B. Garcia, has been acquired by a company formed with local capital. Mr. Mauro Henlitzka, ex-manager of the Compañia Alemana de Electricidad, has been appointed chairman of the new company.

FARADAY HOUSE SPECIAL LECTURES.

Mr. H. M. Hobart, B.Sc., M.Inst.C.E., began this week a special course of lectures on "Electric Railway Engineering" to the third year students at Faraday-house. Mr. J. Rennie, M.I.E.E., of the Board of Trade Laboratory, is also lecturing to them on "Electrical Measuring Instruments."

COMPANIES' MEETINGS AND REPORTS.

HALIFAX AND BERMUDAS CABLE.

Mr. S. Skinner presided at the Halifax and Bermudas Cable Company meeting. He said the net result of the year's working was an available balance of £5,737, as compared with £3,312 for the previous year. The company's cable had worked efficiently. During the year debentures had been paid off to the amount of £10,000, and that debt was now extinguished.

DICK, KERR & CO.

The profits earned during the 12 months trading to June 30, 1910, amount to £22, 820. Out of this has had to be paid Debenture interest and trustees fees, and there has been reserved the sum required to provide for the premium payable on the redemption of the present Debenture stock. These items absorb £12,404, leaving a balance of £10,416, to which must be added the profits brought forward from last year, viz., £63,141, making a total of £73,558 available for appropriation as under: To pay a dividend of 6% per annum on the Preference share capital (the proportion of this dividend to December 31, 1909, has already been paid), £18,300; to pay a dividend of 5% on the Ordinary share capital of £260,000 (to be paid less income tax), £13,000; to carry forward the balance of £42,258. The dividend on the Preference shares will be paid on October 1, 1910, as usual, and the dividend recommended on the Ordinary shares will be paid on same date if approved by the shareholders. The warrants will be posted on September 30. The directors regret that the severe competition referred to in the last annual report has continued throughout the past year.

HOBART ELECTRIC TRAMWAY.

The report for 1909, to be submitted to the meeting on the 5th proximo, states that the traffic and general receipts, although adversely affected for a short period by the New South Wales coal strike, show a substantial increase as compared with any previous year, and furnish gratifying evidence of the steady expansion of the company's business. Owing principally to the fact that a less sum was required to be expended under the head of repairs, maintenance of permanent way, etc., the total working expenses exhibit some reduction in amount, and the net profit, after providing for Debenture interest and all other charges, reached the sum of £8,281. In pursuance of the policy already approved by the shareholders of building up a strong reserve to provide for an insurance fund, for premium on redemption of Debentures, for compensation claims and for other eventualities, the directors have transferred £3,985 from revenue to general reserve account, thus raising the total of the latter account to £5,000. Out of the balance of

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revenue remaining they have declared a dividend on the shares at the rate of 5% per annum, or 1s, per share, free of income-tax, leaving a balance of £1,997 to be carried forward. Advantage was taken of a favourable opportunity which presented itself during the year to acquire a plot of land near the company's terminus on the New Town route, which will, it is anticipated, prove of considerable benefit in the near future. The cost of this land, £475, has been added to capital expenditure account in the balance-sheet.

UNDERGROUND ELECTRIC RAILWAYS.

Sir Edgar Speyer, presiding over the 10th ordinary general meeting of the Underground Electric Railways Company of London, Ltd., held at the offices, Braodway, Westminster, and, in moving the adoption of the report, said that he was glad to be able to record results which, although not yet satisfactory, were considerably better than was anticipated several years ago. The dividends paid on the share capital of the railway companies did not yet represent anything like a fair and adequate return on the large amount of money invested in these enterprises. The report before them gave ample information. As to the accounts, he called attention to the interest items, which, compared with the corresponding period of the previous year, showed a credit of about £11,500. That was mainly due to the interest on the unpaid calls, to the higher bank rate prevailing, and to the conversion of the power house Debentures. Administration expenses showed a saving of over £4,000. The increase in the income from the operation of the power house was due to £3,000 interest on increased expenditure (of which £2,500 referred to the period ended December 31 last) and the balance of £1,700 represented additional profit. The income from investments increased by nearly £13,000. That increase was due not so much to an expansion of traffic receipts, but to a reduction in working expenses of the London Electric Railways. That decrease in costs had been brought about almost entirely by a reduction in the price paid by that company for electric current, and was due to a modification in the power agreement between that company and the railway companies, by which their yearly contributions to the depreciation fund were reduced by about £15,000, and also to economies effected in the working of the plant by the introduction of more efficient turbines. The amount paid for wages on the railways had increased, but that increase was more than offset by the savings just referred to. The increase in rents amounted to about £400, while the amount spent upon property for letting purposes decreased by about £700. There was a growing demand for the company's available sites. As to the London Electric Railway traffic, they could not in the nature of things expect the same quick growth, and they must look forward to a somewhat smaller expansion of earnings than was the case during the first two or three years after the railways were opened. The Charing-cross line had to contend with the competition of the London County Council tramways, which, together with a reduction in fares on that railway, forced upon the company by the very low fares inaugurated by the London County Council, had resulted in a decrease in the traffic receipts during the half-year under review. The London County Council tramways were electrified about a year ago, and it was expected that after November of this year the earnings on the Hampstead line would show an increase compared with the corresponding period.

Lord George Hamilton seconded the resolution, which was unanimously carried.

COMPANIES REGISTERED.

Direct Pneumatic Action Company, Ltd.—£5,500, in £1 shares. Business: Manufacturers of piano machines, piano players, pianos, organs, etc. (mechanical, electrical or otherwise). Private company. Office, 34, Margaret-street, Cavendish-square, London.

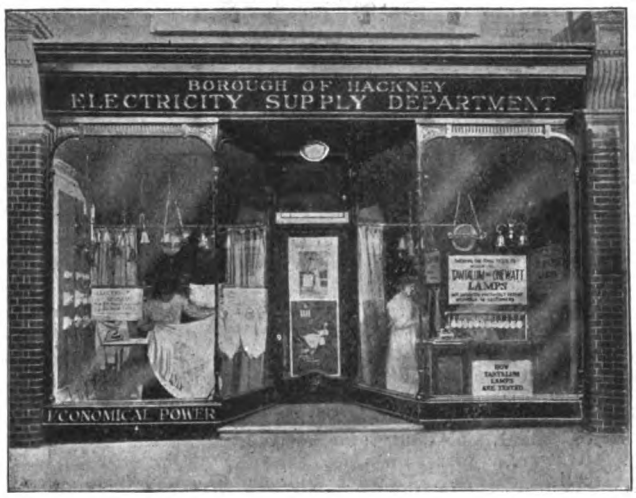
Electric Power Plants, Ltd.—£15,000, in £1 shares (10,000 Preference). Business: That indicated by the title. Minimum cash subscription, 33% of the shares offered to the public. Office, Caxton-honse, Westminster.

Hobart Electric Manufacturing Company.—Capital stock, $200,000, in shares of $100 each. Registered in Tray, Ohio, U.S.A., in August, 1897. British address: 1, 3, Holborn-circus, E.C.

United Lighting and Maintenance Company, Ltd.—£2,000, in £1 shares. Business: That of electricians, etc., carried on by S. Mundler at 35, Cock-lane, E.C., as the National Lighting Company. Private company. Office, 35, Cock-lane, Snow-hill, E.C.

HACKNEY ELECTRIC SHOWROOMS.

We mentioned in our last issue that the Electricity Department of the Metropolitan Borough of Hackney had opened fine showrooms at 306, Mare-street. These have been lavishly equipped with all kinds of appliances and fittings for using electric current, supplied by leading



firms of manufacturers. The Borough last year, although only having a small showroom at the works, had a turnover of some £4,000 by the sale of appliances. It is, however, the policy of Mr. Robinson and his staff to encourage the local wiring contractors and most of the business comes

through their hands. The chief idea of the showrooms is to bring prominently before possible consumers the advantages of electricity and the many household conveniences now manufactured. We give pictures of both the outside and the inside of the premises.

"SUN" SCREWED TUBE SYSTEM.

With reference to our note last week, we omitted one important characteristic with regard to the "Kalkos" switch, this being that it has an earthing dolly. The chief point for notice is that the dolly is earthed only when the cover is fitted, consequently when this is removed to enable any work to be done at the switch, alterations can be carried out without danger of short circuit or shock to the workman. We believe that no other switch on the market at present possesses this advantage, the dolly being earthed irrespective of whether the cover is on or off.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

COUNTY BOROUGH OF HALIFAX.

The Tramways and Electricity Committee of the Halifax Corporation invite TENDERS for the supply of the following PLANT required in their Electricity Department:—

Contract No. 1. One 1,500 kw. Turbo-Alternator complete with Condenser.

Contract No. 2. Two 750 kw. Rotary Converters complete with Transformer.

Contract No. 3. Switchboard and Platform for the above Plant.

Specifications may be seen and forms of Tender obtained on application to Mr. W. M. Rogerson, M.I.E.E., Borough Electrical Engineer, Electricity Works, Foundry-street, Halifax, upon payment of the sum of £10 for each Contract, which will be forfeited should the Contractor not send in a *bona-fide* Tender, or afterwards withdraw his Tender. Tenders, endorsed "Electricity Works, Contract No. —," must be sent to the undersigned not later than 12 o'clock noon on MONDAY, October 17, 1910. The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation. The Committee do not bind themselves to accept the lowest or any Tender.

HERBERT ASHLING,
Town Clerk.

MARKET DRAYTON.

DRAYTON-IN-HALES PARISH COUNCIL.
MARKET DRAYTON FIRE BRIGADE.

TENDERS are invited to SUPPLY and FIX an ELECTRICAL BELL INSTALLATION to the Firemen's Houses for Fire Calls.

Specifications and particulars on application.

Sealed Tenders, marked "Tenders for Electrical Bell," must be sent in to the undersigned by OCTOBER 8, 1910.

The Council do not bind themselves to accept the lowest or any Tender.

All communications to be made to

WILLIAM ROGERS,
Superintendent Fire Brigade.
Ashbourne House, Market Drayton.

APPOINTMENTS.

ELECTRICAL ENGINEER WANTED.

The Committee of Visitors of the County Asylum, Rainhill, invite applications for the post of Electrical Engineer to take charge, under the Medical Superintendent and the Clerk of Works, of the generating plant and wiring at the said Asylum, which consists of three 200 I.H.P. Steam Dynamos, with the necessary steam generating plant and accumulator, and perform any other duties connected with the Electrical Department.

Applicants must have had experience in the running and upkeep of high-pressure Lancashire boilers, economisers, high-speed steam dynamos, accumulators, and switchboards, and must give references to works of a similar nature on which they have been engaged.

Salary £120 per annum, rising to £150, together with house, coal, and light (subject to 3% deduction for Pension under the Superannuation Act). Applications, stating age, past experience, and qualifications, together with copies of testimonials, to be forwarded to the Medical Superintendent, County Asylum, Rainhill, near Liverpool.

APPOINTMENTS—Continued.

NORTHAMPTON POLYTECHNIC INSTITUTE.
ST. JOHN-STREET, E.C.

ELECTRICAL ENGINEERING AND APPLIED PHYSICS DEPARTMENT.

The Governing Body invite applications for the post of Laboratory Demonstrator in the above Department. Applicants should be qualified to take charge of Heat, Photometric and Electrical Engineering Laboratory. Commencing salary £100 per annum.

For particulars and forms of application, which should be returned not later than October 10, 1910, apply to

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

CONTRACTS OPEN.

HOME.

BARKING.—Barking Town Urban District Council.—Tramcars complete with trucks and electrical equipment. Particulars 10s. 6d., Tramways Manager, East-street Works. October 12.

BIRKENHEAD.—The Mersey Railway Company invite tenders for the following supplies: No. 12, electrical sundries; 16, incandescent lamps and fittings; 23, signal wire. Particulars from the Secretary, Central Station, Birkenhead. October 5.

EDINBURGH.—Midlothian and Peebles District Asylum.—Electric fittings, fittings and material for machinery and boilers. Particulars, Clerk, 19, Heriot-row. October 3.

EDINBURGH.—Corporation.—No. 59.—Three steam turbo-generators, each of 1,200 kw. capacity, with the necessary condensing plant.—No. 60.—Interior parts of the cooling towers to deal with 420,000 gallons of water per hour. Specification, £2 2s., Engineer, Dewar-place. October 10.

GLASGOW.—Scottish Exhibition, 1911.—Electric lighting and power installations. Specification, £3, A. Crichton Freeman, 499, Sauchiehall-street, Charing-cross. October 3.

HACKNEY.—Borough Council.—90,000 pairs white, open type, arc lamp carbons. Specification, £1, Town Clerk. October 13.

HALIFAX.—The Tramways and Electricity Committee invite tenders for the following plant: (1) one 1,500 kw. turbo-alternator complete with condenser; (2) two 750 kw. rotary convertors complete with transformers; (3) switchboard and platform for the above plant. Particulars, (£10) from the Borough Electrical Engineer. October 17.

LONDON.—The Secretary of State for India invites tenders for the supply of engines and generators. Particulars from Director-General of Stores, India Office, Whitehall, S.W. October 4.

LONDON.—London County Council invite tenders for the road-work and platelaying required for the re-construction on the conduit system of the Council's tramways in Highgate-road, and for the paving works of certain street widenings in connection therewith. The route is equivalent to about 1½ miles of single track. The contractor will be required to use the track rails with their fastenings, the slot rails, the conductor rails, and the special work for the turnouts, etc., which will be provided by the Council under other contracts, but all the remaining metal work and other materials will be included in the contract. Particulars from the Chief Engineer, County-hall, Spring-gardens, S.W., upon payment to the cashier of the Council of £5. October 11.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage électrique à Béni-Souef—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministère de l'Intérieur," Cairo, will be received up to noon on October 31. The specifi-

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200 to 250 Volts. 32 Watts.
(HALF FULL SIZE).

Brimsdown

PATENT
(COLLOID-TUNGSTEN)
METALLIC FILAMENT LAMPS.

BRITISH MANUFACTURE.

DELIVERY FROM STOCK.

PRICE LIST AND TERMS ON APPLICATION.

Telephone: Gerrard 1728.
Telegrams: "Bulbolite, London."

Imperial Lamp Works (Brimsdown) Ltd.,
SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

Head Office and Works:
BRIMSDOWN, M'SEX.

cations, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

GHENT.—Mechanical and electrical equipment of De la Barque Bridge. Specifications, No. 56, 4d., plans, 2s. 6d., Musée Commercial, 15, Rue des Augustins, Brussels. September 26.

JERUSALEM.—Administrative Council of the Town.—Electric lighting and telephones. Deposit 8%. October 13.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). Specification, Direction des Chemins de Fer d'Outre-mer, Lisbon. October 12.

MELBOURNE.—The Deputy Postmaster-General invites tenders for: (2) Up to 3 p.m. on October 18, for the supply of 23 miles of telephone cable (Schedule No. 284); (3) Up to 3 p.m. on October 18, for the supply of 500 composition insulators (Schedule No. 374); (4) Up to 3 p.m. on October 25, for the supply of 10,000 Cordeau insulators (Schedule No. 373). A deposit will be required with each tender. Local representation is necessary.

PARIS.—The "Moniteur Officiel du Commerce" (Paris) contains a notice inviting tenders for the supply and laying of a submarine cable between Libreville and Loango (Pointe Noire). To qualify tenders, a provisional deposit of 50,000 francs (£2,000) will be required, to be increased by the successful tenderer to 100,000 francs (£4,000). Tenders will be received up to October 14 at the "Bureau de l'Ingenieur Chef des Etudes, Ministere des Colonies, rue Oudinot No. 27," Paris.

SHANGHAI.—Tenders are invited by the Shanghai Electricity Department for the supply of the following: (1) Electric heating and cooking appliances; (2) 10,700 carbon filament lamps; (3) 15,000 metallic filament lamps. Sealed tenders, marked "Tender for Heating and Cooking Appliances," or as the case may be, should be addressed to the Acting Secretary, Council Rooms, Shanghai. Date: (1) October 10; (2) and (3), October 20.

TENDERS ACCEPTED.

HOME.

CHELMSFORD.—The Education Committee have accepted the tender of the Electrical and Motor Company, Banbury, for fitting up the Trinity Road Schools for electric lighting, at a cost of £174 5s.

MAIDSTONE.—The Electricity Committee have accepted the tender of Messrs. William Cory & Son, Ltd., for the supply of "Scotch Screened Washed Peas" coal, at 11s. 6d. per ton, from September 1, 1910, to August 31, 1911.

MANCHESTER.—The Corporation have accepted the following tenders for the Technical College and School of Art:—Motor alternator set, Bruce Peebles, Ltd., £190; shunt machine set, British Westinghouse Electric and Manufacturing Company. Ltd., £75; series motor, Greenwood and Batley, Ltd., £29; single-phase commutator motor, Lancashire Dynamo Company, Ltd., £53; motor-converter set, Phœnix Dynamo Manufacturing Company, £105.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

BLACKBURN: Slones and Atkinson, Ridmond-terrace. Police Station and Sessions Court.

CAMBORNE: A company, Mr. H. Barrow, secretary and manager, is about to erect a Public Hall.

CHESTER: W. T. Lockwood, 88, Foregate. Secondary School.

DUBLIN: T. F. McNamara, architect, 50, Dawson-street. Assembly Hall, Rutland-square, West Dublin.

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ENFIELD: G. E. T. Lawrence, 22, Buckingham-street, Adelphi, W.C. Block of Schools.
LARNE: T. Clearkin, secretary. Technical School.
PLYMOUTH: J. Taton, borough engineer. County Court Offices.
ROTHERHAM: E. Hutchinson & Son, architects, 18, Howard-street. Offices and Dwelling House for Amalgamated Union of Engineers and Firemen.
WELLINGTON: W. Windsor, quantity surveyor, 37, Brown-street, Manchester. Secondary School for 200.

NOTES.

Leamington Enterprise.

Mr. Parry Mell, A.M.I.E.E., M.I.Mech.E., is opening 34. The Parade, Leamington, as a motor garage and electrical works. The workshop will be fitted with all the latest electrically driven machinery suitable for the repair of all makes of motor-cars. The electrical department will be in charge of H. W. Bone, late with the Midland Power Company, Leamington. Country house lighting will be a speciality. During the alterations all motor and electrical work will be carried on at 17, Tavistock Street, Leamington Spa.

"Kingolite" Electric Candles.

With certain styles of decoration the ordinary run of electric lamps are impossible, it is necessary to have either old-world design fittings or candles. The Kingolite Company's electric candle fittings may be confidently recommended, for they are a very good imitation of the true thing, are easy to adjust, and always remain upright. Moreover, they reflect the light partially down the tube, so heightening the illusion that actual wax candles are being used. They are retailed at a reasonable price and the lamps and tubes are renewable at small cost. The company issue a neat illustrated leaflet.

"Spookie" Lanterns.

The Simplex Conduits Spookie Night Watch Electric Lanterns proved a great success last season, but the new ones are sure of even wider popularity. Instead of being round, they are now made square. Practically it is a shade, with wooden frame, finished to immediate hammered iron, with small panes of red, green, yellow or white glass, and made to fit over any form of electric fitting. They do admirably for shop window decoration, or for permanent and temporary decoration in conservatories, halls and verandahs.

Holophane Stiletto Reflectors.

Messrs. Siemens Brothers Dynamo Works Limited, Tyssen Street, Dalston, London, N.E., inform us that they are in a position to take orders for Holophane Stiletto Reflectors. A previous notice in these columns has been inserted to the effect that these were being placed on the market, and Messrs. Siemens now inform us they will be supplied in three types, namely :—Type E, or extensive, *i.e.*, distributing ; Type I, or intensive, *i.e.*, concentrating ; Type F, or focussing, *i.e.*, very strongly concentrating. These are supplied in various sizes, the price for each size being the same, whether Type E, I or F is ordered, as follows :—

		s.	d.
Types E, I and F	25 ..	3	0
,, ,, ...	40 ..	3	3
,, ,, ...	60 ..	3	6
,, ,, ...	100 ..	4	9
,, ,, ...	150 ..	9	6
,, ,, ...	250 ..	12	0

Stocks are held of all sizes up to and including No. 100, and it is hoped that the 150 and 250 sizes will be ready shortly. Messrs. Siemens are preparing literature regarding these specialities and will be pleased to receive enquiries for same, accompanied by trade card. The reflectors will be supplied with crinkled or plain edges, the crinkled being supplied unless the plain are specially ordered. The crinkled edges are recommended as giving this handsome type of reflector the best possible appearance.

"Multax" Lamps for Railways.

The Globe Electric Company, Ltd., have just received a further order for 24 "Multax" lamps for the Bengal-Nagpur Railway, this making the third repeat order during the present year.

Cardiff Agents for Bruce Peebles.

Messrs. W. V. Waite & Company, Ltd., engineers' contractors, etc., Gordon-chambers, 31, Queen-street, Cardiff, have just been appointed agents for the South Wales district for Messrs. Bruce Peebles & Company, Ltd., Edinburgh.

British Built Diesel Engines.

On October 1st next Messrs. Willans & Robinson, Ltd., of Rugby, are placing a line of Diesel Engines on the market. During the past five years this firm have acted as manufacturers of the engine for Messrs. The Diesel Engine Company, of London, but they have now made arrangements for placing the engine on the market themselves, and for dealing direct with customers both in Great Britain and for export. It might be mentioned that Messrs. Willans & Robinson, Ltd., are manufacturing these engines in standard sizes, ranging from 120 b.h.p. up to 600 b.h.p.

New "Onewatt" Lamps.

Messrs. Siemens Brothers Incandescent Lamp and Fittings Department, Tyssen-street, Dalston, inform us that they are placing on the market a range of 50 volt "Onewatt" lamps, 10 and 16 c.p. in Bell shaped and Spherical bulbs. They are now listing Battery lamps, 1·3 to 16 volts, 100 c.p. lamps, 200 to 250 volts, and 10 and 16 c.p. lamps, 20 to 50 volts, all of the "Onewatt" type, with Drawn Tungsten Filaments. The prices of the new 50 volt lamps are, we are informed, low, and Messrs. Siemens Brothers are prepared to supply quantities of literature regarding same upon receipt of application accompanied by trade card. It seems probable that during the coming lighting season other types of "Onewatt" lamps will be placed on the market.

AMERICAN WESTINGHOUSE COMPANY.—By paying off the arrears of $8\frac{3}{4}\%$ on its 7% Preferred stock the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, wipes out a reminder of the crisis of 1907. The company had over-extended its credit, and receivers were appointed in October, 1907, being discharged in December, 1908, when the company's finances were reorganised. In October last year Preferred dividends were resumed with the payment of $1\frac{3}{4}\%$ for the quarter to September 30 and $3\frac{1}{2}\%$ on account of arrears, leaving $8\frac{3}{4}\%$ still outstanding. Since then the regular quarterly dividends have been forthcoming, and now the arrears have been covered. It is not a great feat, as the total was only $349,886, and the company showed a surplus, after charges, of $3,060,660 on the trading of the year to March 31 last.

PATENTS.

Centre Contact Electric Lamp Holder.

26043.—1909. H. E. SHEWARD, Hammersmith. The vulcanite part of the plug connection is provided with a shoulder. A metal tube which is connected to the screw stem of the lamp holder has a turned-in lip which engages with the shoulder. The plug connections can be moved by hand to engage or disengage the plug from the lamp terminal or contact, and so act as a switch. The connections are retained within the tube.

Railway Block Signalling Systems.

26487.—1909. SOCIETA IN ACCOMANDILA PER L'ITILIZZAZIONE DELLE INVENZIONI ING BEER, Venice. The block instruments are interlocked with one another in such a manner that it is impossible to set a starting signal for a train at a station unless the track rails of the section to be passed over by the train are intact and not occupied by another train, engine or vehicle.

Electric Bell Push.

28557.—1909. H. HIRST AND S. D. WHITE, London, E.C. The electric bell push is fitted into the handle of a paper knife. The leads for connecting the bell to the circuit pass down the centre of the handle and out through a side hole.

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
HULL.

Electricity Meters.

16332.—1909. W. H. JOHNSON AND A. M. BILLINGTON, Westminster, S.W. Hitherto electricity meters of the motor type, in which a brake is employed comprising an electro-magnetic circuit, have only been capable of registering true watt hours on circuits of a standard pressure, since variation in pressure of a circuit has resulted in a variation in field strength of the braking electro-magnet, and a consequent variation in the speed of the motor. The object is to overcome this disadvantage by providing an electro-magnetic braking circuit, the field strength of which in the region of the gap in which the brake disc works is constant throughout a wide variation of voltage of any circuit to which the meter may be applied. The energising windings of the brake electro-magnet are arranged upon parts of the metallic circuit adjacent to the gap, so that the flux density is the same at the poles as at any cross section in the core within the energising windings, the number of turns of the latter being large in proportion to the cross-sectional area of the core. By this means the magnetic leakage can be entirely eliminated and a strong field gap produced.

Filament for Heating Units.

18954.—1909. PARKER-CLARK ELECTRIC COMPANY, New York, U.S.A. This is a new process to produce a filament which will withstand strong vibration and high resistance. A mixture of 2% olefiant gas and 98% hydrogen is passed over a vaporiser containing silicon tetrachloride and into a flashing jar in which a conducting core or base of carbon is arranged. The jar may be run up to atmospheric pressure or above, and the flashing carried out in the usual manner, but better results are obtained by working slightly above atmospheric pressure and allowing the gas to flow through the receiver. This process may be continued so that any size resister may be obtained; that is, the building-up process may be carried forward to any desired point. When the current is turned on through the conducting core and the gases are decomposed to build up the filament by deposition, the reaction is essentially as follows: $C_2H_4+SiCL_4$ (and hydrogen in excess) = $SiC_{\frac{1}{2}}+4HCL$ (and hydrogen in excess).

Electric Current Supply.

19660.—1909. J. A. FARRAND, Bury. This coin-reed apparatus for supplying electricity comprises a main-spring placed inside a barrel. The inner end of the main-spring is attached to the barrel arbor. The outer end of the spring is attached to the side of the barrel, which has teeth on its periphery gearing into train wheels. The barrel and barrel arbor are geared to a cut-out, which consists of a disc provided with a slot for cutting off the electric current. A wire attached to the ampere meter prevents the main-spring from running down, as the wire comes in contact with the balance wheel when the current ceases to pass through the meter.

Electric Conduits.

20067.—1909. R. BULLER AND A. H. GIBBINS, Liverpool. The junction box, which comprises two parts connected together by bolts and fitted with conduits for the electric cables, has gradually tapered recesses at the ends. The recesses decrease in diameter towards the outer ends and have flat-shouldered surfaces at their larger ends. The ends of the conduits are gradually tapered to fit into the recesses, while the end faces of the pipes abut directly against the shoulder surfaces.

Rectifying Electric Currents.

19090.—1909. T. J. MURPHY, Rochester, U.S.A. A pair of electrodes is connected with the terminals of a course of alternating current. A common return wire is connected to a point in the circuit between the pairs of electrodes. The electrodes of each pair are placed in proximity to each other, but sufficiently removed so that a current will not flow, inasmuch as the potential of the source is insufficient to bridge the gap between the electrodes. A source of high potential current is connected to the electrodes. The potential of the second named source is sufficiently great to establish an arc across the electrodes. A condenser is connected between the terminals of the second named source, and at proper times it is discharged across first one pair of electrodes when the current of the first-named source is flowing in one direction, and then across the other pair of electrodes when the current is flowing in the opposite direction. An electric valve and inductance device regulate the times of discharge of the condenser and completion of the circuit having the high potential source of current. The electric valve employed forms the subject of patent 3410.—1910, and comprises a disc and a resistance body opposed to the disc. The two parts are adjustable with reference to each other. A non-conductive medium is located between the disc and the resistance wire. The valve allows pulsations to pass in but one direction through the non-conductive medium.

Registering Device for Ship's Telegraph.

21934.—1909. A. G. ELLIOTT, Berkeley, U.S.A. A crank arm is caused to move in correspondence to the signals shown on the indicator. The arm crank is connected to a lever which carries an arm to which a pencil is attached. The pencil marks a recording strip which is wound upon continuously rotating drums.

Block Signalling Apparatus.

22319.—1909. E. F. BOUR, Mauritius. This is an improvement in railway signal systems of the kind in which three devices arranged on the engine correspond with three devices arranged on the permanent way. Two of the latter devices are situated at the home station, and the other at the station next ahead of the home station. The home station devices comprise two pivoted levers connected together in such manner that when one is raised the other is lowered. One of these levers, the setting lever, normally assumes a vertical position, while the other lever, the danger lever, is normally retained in a depressed position by the action of a spring. A spring pressed catch retains the danger signal in its upright position when the setting lever has been depressed by the passage of a train. The catch is mechanically released through a cable or wire by the depression of a lever at the distant station, or by a pneumatic arrangement operated by the passage of a train. Each of the devices on the permanent way co-operates with an inclined plane on the engine. The setting lever engages a fixed inclined plane, while the danger lever (when in operative position) engages a pivoted plane and operates an alarm on the engine and automatically closes the throttle independently of the regulating handle. A pneumatic arrangement controls the catch device, and an electric alarm warns the driver.

Telephone Transmitters.

26779.—1909. K. O. LEON AND C. C. LEWIS, London, W. The mouthpiece of the transmitter takes the form of a short cylinder to the outer end of which is fitted an india-rubber cap so shaped as to completely enclose the lips of the person using the telephone and preventing his conversation from being audible to other persons in the room.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.						Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Sept. 14	1,458	1,393	+ 65	— 178	27¼	27¼	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,001	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Sept. 18	1,089	1,077	+ 12	+ 098	24·089	24·089	—	—	—	—	—	—	—	—
Birmingham Corporation	Sept. 17	6,859	6,502	+ 357	+ 2,275	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Sept. 17	5,001	4,889	+ 112	+ 4,146	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Sept. 25	1,075	1,052	+ 23	+ 72	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Sept. 23	6,237	5,861	+ 376	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Sept. 24	1,180	1,288	— 108	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Sept. 25	251	259	— 8	— 14	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Sept. 24	5,688	5,255	+ 433	+ 3,832	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27*a*
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Sept. 25	3,173	3,216	— 43	+ 193	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Sept. 22	502	550	— 48	+ 1,699	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Sept. 9	1,663	1,603	+ 60	+ 3,385	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Sept. 23	169	163	+ 6	+ 121	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Sept. 23	5,454	5,563	— 109	+ 1,392	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Sept. 24	1,115	1,005	+ 110	+ 812	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Sept. 17	19,271	17,939	+ 1,332	+ 14,961	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Sept 24	2,618	2,572	+ 45	+ 3,460	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Sept. 21	144	142	+ 2	— 185	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Sept. 21	1,357	1,419	— 62	— 553	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Sept. 18	1,395	1,374	+ 21	+ 158	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Sept. 14	41,727	37,694	+ 4,033	+ 130537	132½	124	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Sept. 24	10,480	9,829	+ 651	+ 7,542	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Sept. 25	17,483	16,970	+ 513	+ 6,468	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2¾	2¾	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Sept. 17	3,740	3,665	+ 75	+ 1,116	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Sept. 18	6,013	5,690	+ 322	+ 8,903	40	39½	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Sept. 14	1,184	1,151	+ 33	+ 614	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 10	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,830,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Sept. 17	987	955	+ 31	+ 232	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	+ 97	+ 1,985	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. *h* Half-years' figures.

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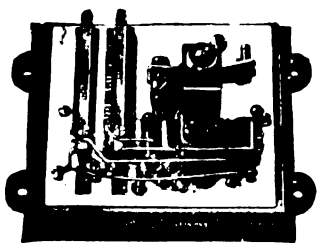

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British Westinghouse Electrical and Mfg. Co., Manchester.
Electric Construction Co., Dashwood House, 9, New Broad-street, London, E.C.
Ferranti Limited, Hollinwood, Lancs.
General Electric Co., 71, Queen Victoria-st.
Johnson & Phillips, Old Charlton, Kent.
McClure & Whitfield, Stockport.
Morris-Hawkins, 30, St. Mary Axe, E.C.
Sandycroft Foundry Co., Chester.
Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W.
Union Electric Co., Park-street, Southwark, London, S.E.

Ebonite and Vulcanite.
F. Carson & Evans, 3a, Fenchurch-buildings, London, E.C.
Mosses & Mitchell, 69, Chiswell-street, E.C.
Traun, Dr. Heinr., & Son, 8, Redcross-street, London, E.C.

Electric Cooking Apparatus.
British Thomson-Houston Co., Rugby.
General Electric Co., 71, Queen Victoria-st.
British Prometheus Co., Ltd., Salop-street Works, Highgate, Birmingham.

Electrical Fittings and Appliances.
British Thomson-Houston Co., Rugby.
Dorman & Smith, Ordsal Station, Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Ferabin Lamp and Accessories, Ltd., 118, Queen Victoria-street, London, E.C.
Flexible Metallic Tubing Co., Ponders End, & 112, Queen Victoria-st., London, E.C.
General Electric Co., 71, Queen Victoria-st.
Lundberg, A. P., & Sons, Pioneer Electrical Works, 477 to 487, Liverpool-road, N.
McGeoch, Wm., & Co., 28, West Campbell-street, Glasgow.
Metallic Seamless Tube Co., Wiggin-street, Birmingham.
New Brotherton Tube Co., Commercial-road, Wolverhampton.
Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W.
Sun Electrical Co., 118 & 120, Charing Cross-road, London, W.C.

Electric Heaters.
McGeoch, Wm., & Co., 28, West Campbell-street, Glasgow.
British Prometheus Co., Ltd., Salop-street. Works, Highgate, Birmingham.

Electric Meters.
Adnil Electric Co., Ltd., Adnil Buildings, Artillery-lane, Bishopsgate-street, E.C.
The Leysner Electrical Instrument Co., 12, Lime-street, E.C.

Electric Light Contractors.
British Thomson-Houston Co., Rugby.
Ferranti Limited, Hollinwood, Lancs.
Hooper's Telegraph & Indiarubber Works, 31, Lombard-st., E.C., & Millwall Docks.
Johnson & Phillips, Old Charlton, Kent.

Electric Locomotives.
British Thomson-Houston Co., Rugby.

Elevating, Conveying Plant, Cranes, etc.
General Electric Co., 71, Queen Victoria-st.
British Westinghouse Electrical and Mfg. Co., Manchester.
Ferranti Limited, Hollinwood, Lancs.

Engines.
Allen, W. H., Son, & Co., Queen's Engineering Works, Bedford.
Belliss & Morcom, Ledsam-street Works, Birmingham.
Browett, Lindley, & Co., Patricroft, Manchester.
Crossley Bros., Ltd., Openshaw.
Petter, J. B., & Sons, 73, Queen Victoria-street, London, E.C.
Willans & Robinson, Rugby.

Engine Accessories, Tanks, etc.
Babcock & Wilcox, 30, Farringdon-st., E.C.
Croft & Perkins, Ltd., Bradford.
Dore, J., & Co., High-st., Bromley-by-Bow.
Harvey,G. A., & Co.,Lewisham,London, S.E.
Willcox & Co., 36, Southwark-street, S.E.

Engineers' Stores.
Willcox & Co., 36, Southwark-street, S.E.

Feed-Water Heaters.
Wilkinson, Geo., Beech Mount, Harrogate.

Fire Extinguishers.
The Valor Co., Ltd., Ashton Cross, B'gham.

Flexible Couplings.
Croft & Perkins, Ltd., Bradford.

Galvanisers.
Harvey,G.A., & Co., Lewisham, London, S.E.

Incandescent Lamps.
British Thomson-Houston Co., Rugby.
Cryselco Ltd., Kempston Works, Bedford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Ferabin Lamp and Electrical Works, 118, Queen Victoria-street, London, E.C.
General Electric Co., 71, Queen Victoria-st.
Henley's, W. T., Telegraph Works Co., Blomfield-street, London-wall, E.C.
Imperial Lamp Works (Brimsdown), Ltd., Kingsway House, Kingsway, W.C. Works, Brimsdown, Middlesex.
Stearn Electric Lamp Co., 47, Victoria-st., S.W.

Indiarubber Goods.
Moseley, D., & Sons, Chapel Fields Works, Ardwick, Manchester.
Willcox & Co., 36, Southwark-street, S.E.

Insulating Varnish.
Ammon, A. F., 52, Chapel-street, Blackfriars, Manchester.
Major & Co., Sculcoates, Hull.
Pinchin, Johnson & Co., Ltd., Bevis Marks, London, E.C.

Insulators and Insulating Materials.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Everitt & Co., 40, Chapel-street, Liverpool.
General Electric Co., 71, Queen Victoria-st.
Griffiths Bros., Mack's-rd., Bermondsey, S.E.
Hooper's Telegraph & Indiarubber Works,31, Lombard-street, E.C., & Millwall Docks.
Johnson & Phillips, Old Charlton, Kent.
Keys, W. H., Hall End Works, West Bromwich.
Macintyre, J., & Co., Washington China Works, Burslem.
Mosses & Mitchell, 69, Chiswell-street, E.C.
Price, Powell, & Co., Bristol.
Traun, Dr. Heinr., & Son, 8, Redcross-street, London, E.C.

Jointing.
John Hudson & Co.'s Successors, 4, Victoria Warehouses, Mansell-street, E.
Everitt & Co., 40, Chapel-street, Liverpool.

Ladders and Steps.
Heathman, J. H., & Co., Parson's Green, S.W.

Lamp Columns for Arc Lighting.
General Electric Co., 71, Queen Victoria-street, E.C.
Johnson & Phillips, Old Charlton, Kent.

Lampholder Makers.
Dorman & Smith, Ordsal Station Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
General Electric Co., 71, Queen Victoria-st.

Lead-Covered Cables.
Callender's Cable & Construction Co., Hamilton House, Victoria Embank't, E.C.
Johnson & Phillips, Old Charlton, Kent.
London Electric Wire Co., Anchor Works, Playhouse-yard, E.C.

Manganesite.
John Hudson & Co.'s Successors, 4, Victoria Warehouses, Mansell-street, E.

Manganese Oxide.
Everitt & Co., 40, Chapel-street, Liverpool.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Tramcar Motors.

During the Tramways Conferences at home and abroad we have heard much about the economy of current by using meters, lightening the construction of cars, improving lubrication and brake efficiency, and even recuperation of energy, but little was said about motor types and efficiency. Yet this has a very important bearing on economy of current and breakdowns. More attention deserves to be paid to this aspect of tramway engineering, and bolder experiments are needed. Messrs. Siemens Brothers & Company, Ltd., are doing something in this direction, for they have introduced a series-shunt system of control, the motors being both series and shunt wound. The idea is to secure the advantages of series windings without the di advantages of rheostatic losses when starting the car. The control of the new motor is simply the inserting or cutting out of resistance in the shunt windings. In this way not only can the car be started on the shunt windings (and then return of current to the line is secured even when coasting), but great flexibility as regards speed can be obtained. This type is giving excellent results on both sides of the Channel, and more should be heard of it in the future. Experiments on other lines are also necessary, as in the case of the Berlin and Hamburg aluminium wire wound motors.

Magnetism and Alloys.

Although dealing with purely experimental work, Mr. A. D. Ross's paper on "Magnetic Alloys Formed from Non-magnetic Materials," read before the Institute of Metals, opens up most interesting problems which may present considerable practical importance to electrical engineers. In the discussion which followed the paper (an abstract of which appears in another column), the phenomena seemed to be generally attributed to the presence of manganese. Even so, the great variation in magnetisation produced by the use of high or low temperatures, annealing and tempering are certainly deserving of the closest investigation.

Welsh Industry and Electricity.

On very excellent authority we know that the Welsh tin-plate industry died some few years ago and is "gone." Still, for an "absent corpse" it manifests rather striking energy, and we now find that 34 new tinplate mills are going up in South Wales, especially round about Swansea. Electricity is to be largely used, perhaps on the principle of galvanising this curiously "dead" and flourishing industry into even greater prosperity. Barry, too, is to be made the centre of a big enterprise, involving the expenditure of over a million, and to include coal washeries, coke ovens, blast furnaces, coal-tar distillery and electric power station. Here there will also be tinplate works, as well as steel foundry and galvanising works. Not the least interesting phase of this huge industrial development is the project to lay out a big garden city for the workpeople. This ought to prove a splendid opportunity to demonstrate the use of electricity in helping forward such a project, from supplying traffic facilities to lighting homes and providing all the power necessary to run domestic affairs cheaply and smoothly.

Poulsen Wireless Lighting.

Mr. Valdemar Poulsen, the inventor of the Poulsen wireless telegraphy system, has of late been turning his attention to wireless electric lighting, and has, apparently, succeeded in devising a very remarkable system. According to telegraphic communication from Copenhagen, it appears that Mr. Poulsen's assistant held two incandescent lamps in one room while the inventor went into another, and after placing his transmitting apparatus in position, succeeded, in the presence of numerous visitors, in lighting the lamps in the other without the aid of any ordinary mechanical connection.

Hydro-Electrics in New Zealand.

In our issue of September 2 we mentioned that the New Zealand Government were taking a strong stand as regards hydro-electrical developments, and mentioned the policy foreshadowed by the Prime Minister, Sir Joseph Ward. More of this was heard on the recent introduction of the Budget, when the Hon. R. McKenzie (Minister of Mines and Works) devoted the greater part of his speech to the question of the development of electrical energy. He stated that the proposal to borrow £500,000 for water-power works was one of the greatest proposals that had been submitted to Parliament since Sir Julius Vogel formulated his Public Works Policy. Members had not grasped the full significance of the proposal. It would benefit the farming and every section of the community, and would benefit all future generations. The subject was the biggest and most important that had ever been dealt with by Parliament. In America a "trust," composed of most of the big companies in the States and Canada, had been acquiring water power monopolies, both in the States and in Canada. At the head of this trust was the Standard Oil Company and the Steel Trust. The tammanyism referred to by the Leader of the Opposition was a mere trifle in comparison with the operations of this Trust. They should take care that no such trust was ever formed in New Zealand.

New Zealand Schemes.

In referring to the different water powers, he said that the power at Te Anau and Manapouri was sufficient to manufacture 6,000,000 lbs. of nitrate per annum. The Lake Coleridge primary scheme could be established for £150,000, and the surplus power in connection with any scheme could be utilised in connection with the manufacture of nitrates, as the process was not an expensive one. The member for Dunedin North (Mr. G. M. Thomson) had been in communication with the Government in this matter, and reports from other countries had been obtained. In the North Island there were several powers. There was a small power in the Hutt Valley, another at Featherston, and also a small one at Otaki. In the Rangitikei there was a good power, but the best power of all in the North Island was on the Kaituna river, flowing into the Bay of Plenty. At Waikaremoana there is a drawback. The reports state that there is some uncertainty there because the water comes from underground and nobody has yet found out where the outlet is.

Mining and Traction.

Mr. McKenzie wound up a statement which was eagerly listened to by saying that there were powers available in New Zealand that would develop four million h.p., and at present 250,000 h.p. was sufficient for all the industries and the railways in New Zealand. The development of of electrical power in connection with both quartz and alluvial mining would be something marvellous, and in regard to railways the time was close at hand when they would be worked electrically. It had already been decided to work the Arthur's Pass section of the Midland Railway in this way when it was ready.

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New Uses for Electricity.

Quaint instances of the use to which electricity is put crop up every day. Two of the latest may be mentioned. Mr. R. H. Williams, assistant secretary of the Great Yarmouth and District Members Cycling Club, has devised a thoroughly practical timing apparatus. On one side of the road is a stake with a reel of cotton fixed to it, the cotton stretching across the road about one foot from the ground, and being connected on the other side of the road to a light trip switch. There is a switch at the start and finish. When a competitor's machine comes into contact with the cotton it gives a slight pull before breaking, which is sufficient to trip the switch. The switch is connected to the magnet (placed over the watch) and starts the watch. The switch at the finish in the same manner stops the watch, and so records the exact time taken. One mile of twin wire was used at the demonstration speed trials for connecting the switch at the finish with the one at the start, the wire being brought over the drum. The second example is decidedly odd. It is nothing less than self-illuminated electric album for displaying colour-photographs. It is the invention of a Monsieur I. Duchenne, who uses a folding frame, arranged on the screen principle, fitting over an album shaped box containing two electric lamps.

Fans on Shipboard.

We publish in another column the report of a case heard in the City of London Court, which is likely to stir up passenger ship companies to a livelier sense of their responsibilities as regards sanitation. Mr. Justus Eck, of the Union Electric Company, succeeded in recovering from the Union Castle line a sum of money paid as passage money on the ground that the first-class cabin assigned to his wife and daughter on their return from the Cape was without ventilation. The company, it was proved, advertised that their ships were properly ventilated by means of electric fans, but there was no fan in the cabin complained of. The porthole had to be kept closed owing to the high prevailing winds. Judgment was given against the company, and certainly many thousands of passengers will have reason to thank Mr. Eck for the trouble he has taken over the matter.

Electric Lighting Further Powers Bill.

Both Barking and Tynemouth have decided to back the promotion of the Bill with financial help. While Stepney will give moral support, and will consider giving financial support when Bill is deposited.

Law Relating to Engineering.

The Council of the Society of Engineers (Incorporated), in conjunction with the Council of the Junior Institution of Engineers, have arranged for a course of six lectures on "The Law Relating to Engineering," to be delivered by Mr. L. W. J. Costello, M.A., LL.B. (Cantab), at Caxton Hall, Westminster, at 7.30 p.m., on the following dates: Monday, October 10; Tuesday, October 25; Wednesday, November 9; Monday, November 21; Wednesday, December 7; and Monday, December 19. Fee for the course: Members, 6s.; non-members, 12s. At the close of each lecture opportunity will be given for the asking of questions and for discussion. Applications for tickets should be made to the Secretary of the Society of Engineers, at 17, Victoria-street, Westminster; or to the Secretary of the Junior Institution of Engineers, 39, Victoria-street, Westminster.

National Electrical Manufacturers' Association (Incorporated). — The half-yearly general meeting of the above Association will be held at the Midland Hotel, Manchester, at 2.30 p.m. on Tuesday, October 11 next.

CORONATION EXHIBITION.

Empire Display at the Great White City.

The great historic event of next year—the Coronation of King George V. as King of the United Kingdom of Great Britain and Ireland; of the British Dominions beyond the Seas, and Emperor of India—will be celebrated at the Great White City, Shepherd's Bush, by an exhibition which will show the dominion, power and infinite resources of the British Empire.

It will be a Coronation Exhibition. From every quarter of the Globe, the most salient features of the Empire will be collected at the Great White City, where the many native races dwelling at peace beneath the British flag will exhibit their industries and products.

The Coronation Exhibition will be the centre, in which all the varied races and peoples of the Empire on which the sun never sets, will meet.

A strong Committee has been formed, and active preparations are on the way to ensure that the Exhibition shall be worthy of the historic occasion which has called into being.

The United Kingdom too, will take its part. The wonderful resources and epoch-making industries of England, Scotland, Ireland and Wales will all be in evidence.

The authorities of the Exhibition will devote a proportion of the receipts to the Mansion House Fund, for a National Memorial to our late Monarch, King Edward VII.

The success attained by the previous exhibition at the White City shows that there is every prospect of this contribution reaching to a very large figure.

Meanwhile, the Exhibition authorities have decided to guarantee that their donation to the Fund shall not be less than £5,000.

PUBLICATIONS RECEIVED.

"Proceedings of the Incorporated Municipal Electrical Association. Price 5s.

This contains a full report of the 15th annual convention, held at Glasgow last June. It includes the papers read and discussions thereon, together with a list of members.

"The Physical Review," September.

Among the articles in this issue are the following: "Determination of the Wave-Length and Logorithmic Decrement of the Linear Electrical Oscillator with the Interferometer," by J. E. Ives; "Nature of Spark Discharge at Very Small Distances," by Elmer H. Williams; and "Temperate Co-efficients of Electrical Resistances," Part II., by A. A. Somerville.

"The Motor Annual." The Temple Press, Ltd. Price 1s. 6d. net.

This is the 13th edition, and is crammed full of useful information and excellent diagrams.

FINANCIAL NOTES.

South Metropolitan Electric Light and Power.—The warrants for interest on the company's 4½% first mortgage debenture stock for the half-year to October 1, 1910, have been posted.

* * *

Mexican Light and Power.—The directors of the Mexican Light and Power Company, Ltd., have declared a dividend of 1% on the Ordinary shares for the quarter ended September 30, 1910.

* * *

Brisbane Electric Tramways Investment Company.—The directors have decided to pay on November 1 an interim dividend of 4s. per share (or at the rate of 8% per annum) on the Ordinary shares, as compared with 3s. 6d. per share last year. In regard to dividends on the Ordinary shares, the directors intimate that, notwithstanding a substantial increase in net receipts, their policy is to recommend that the distribution in the immediate future should be restricted to 8% per annum, and that the surplus profits, after making adequate provision for depreciation, should be reserved for the equalisation of dividends and the general purposes of the company.

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ELECTRIC STEEL REFINING.*

By D. F. Campbell.

The use of electricity for the refining of steel has now taken its place amongst established metallurgical processes, and many papers have been written on the subject of electric furnaces, but the author proposes to discuss briefly the general aspects of the subject, and what he considers the probable and possible developments in the immediate future in England. The electric furnace is at present used in various works for the refining of steel from the Bessemer converter in the manufacture of rails and all classes of railway material and castings, and more commonly in connection with the basic open-hearth process for the manufacture of various products of intermediate quality, castings and tool steel of all kinds. These are the purposes for which it has been most widely adopted, notably in America, Germany and France, though it is also used for melting and refining charges of cold scrap of cheap quality for the manufacture of tool steel and small castings, and its high efficiency is now generally acknowledged. The refining of steel that had been previously melted was the first use to which the electric furnace was applied commercially; but now that single furnaces have been producing over 200 tons a day for more than 16 months, it is obvious that the field for the process has widened, and already many furnaces are in construction or operation in this country.

The author is of opinion that the electric furnace is especially suitable, and will be widely adopted, for any class of work in which raw materials of a high degree of purity are now used.

A wider application for rails and sections may occur when working in connection with the Talbot furnace, for the charge can be taken to the electric furnace as soon as the carbon is down, and the necessity of removing the sulphur and getting a teeming heat is avoided, as this is done in the electric furnace both economically and completely. Thus the capacity of the Talbot furnace is substantially increased, and this covers the greater cost of electric refining.

Again, in the case of a basic open-hearth plant, using 60% of molten pig iron and 40% of scrap, a 40-ton furnace might have 15 tons removed to the electric furnace for refining, and a similar charge put in every two hours. Thus the capacity would be increased, the quality improved, and, in addition, a reduction in the cost of raw materials can also be made in some cases, as a low quality of pig iron can be used.

Similar conditions occur when working in conjunction with an open-hearth plant for making castings, and a thoroughly dead melt and extreme fluidity can be obtained, while the commonest raw materials can be used, and refined completely. This gives economy both in the amount of gits and runners, and also in the reduction of wasters. Even in the case of foundries engaged in ordinary open-hearth casting work, in which the margin of profit is now exceedingly small, the electric furnace is considered necessary for an improvement in quality, while in a small foundry making light and intricate castings from crucible steel, an economy of several pounds per ton may be expected to result from the adoption of the electric furnace, judging from the reduction of the costs in works in Germany where crucible furnaces were replaced by this process.

There is little doubt that crucible steel, Swedish billets, and products of intermediate quality, such as are used for the Sheffield trade and by tube-makers of Staffordshire and South Wales, can be economically replaced by steel refined by electricity, and made in Middlesbrough, Cumberland, or the larger steelworks in the Sheffield and Rotherham districts.

The use of the electric furnace is not likely to become general for rail steel manufacture at the present time, except in cases where the conditions are exceptional. In certain cases, such as at South Chicago, it has been adopted for that purpose owing to the economic conditions, notably the scarcity of good Bessemer ores and the demand for better rails. The electric furnace in such cases may save Bessemer plants from the scrap heap, or, at any rate, prolong the life of present installations, and at the same time make it possible to produce rails of a quality better than the best open-hearth steel, thus avoiding heavy capital expenditure.

In the electric furnace, almost any degree of refining can be economically effected, and the removal of sulphur, phosphorus, and oxygen is especially easy. This is probably due to at least three causes:—

1. The intense heating of the slag, which is the place at which refining takes place. Owing to this high temperature and the extreme fluidity of the slag, the rate of the refining reaction is very great, because the velocity of reaction rises very quickly for high temperatures, and not in direct proportion to the temperature.
2. The extremely basic slag that can be kept in a very fluid state, and the calcium carbide formed by the action of the arc on the calcareous slag, are especially advantageous for desulphurisation.
3. The violent motion of the steel, which results from the convection currents produced in the bath, due to the two intensely hot areas caused by the arcs below the electrodes, increases the volume of steel exposed to the hot and fluid slag area, and hence the rate of refining.

The usual procedure for the use of the electric furnace in connection with the Bessemer converter is to charge the steel, holding back all slag in the ladle, after putting on the bottom of the furnace, lime and mill scale or iron ore. This produces an oxidising or dephosphorising slag, which may be carefully skimmed or poured off. On the bath of steel carbon is thrown to carburise to any required degree, and then a second highly basic and desulphurising slag is added. The arc acting on the calcareous slag produces calcium carbide, which may combine with sulphur to form calcium sulphide. As neither gases nor air enter the furnace, and the conditions are almost completely reducing, no sulphates are formed, a dead melt is easily obtained, and when the slag is molten and the requisite heat obtained, the steel is teemed. In the open-hearth or any oxidising furnace these reactions cannot take place so completely and efficiently.

With steel from the basic open-hearth furnace the procedure is similar, but when the quantity of phosphorus to be removed is small, it is only necessary to use one refining slag for the elimination of sulphur and any small amount of phosphorus remaining. The usual practice is to put the carbon necessary for carburising in the bottom of the furnace, and then add the steel and the basic slag materials. As soon as the teeming heat is obtained, the necessary ferro-alloys are added, and the steel will be completely refined.

Another point of interest is the rarity of blow-holes in electric steel when properly made, and this leads to the question of the cause of these troubles. It is well known that any ingot of steel when placed in a vacuum evolves nitrogen, and this is about equally true whether it be made in the crucible, the Bessemer converter, or the electric furnace. Blow-holes contain nitrogen, but this is probably not the cause. It is far more probable that they are due to the combination of oxides with the carbon in the process of cooling, and that the carbon monoxide so formed at a high temperature causes blow-holes in the cooling steel, and owing to the diminution of volume of the carbon monoxide on cooling, a partial vacuum is formed, and nitrogen is sucked into the blow-holes. In electric steel, oxides do not occur in any quantity, and, consequently, the prime cause of blow-holes is reduced.

Again, the quality of electrically refined steel is better than a material of similar chemical composition made in any oxidising furnace. This is probably due to the reducing conditions under which it is finished.

It must not be forgotten, in discussing these special qualities of electrically refined steel, that some inferior material has been made by incompetent melters or in ineffective furnaces, and that the electric, just as much as any other furnace, requires trained men, and most careful designing by metallurgists who have made a special study and had practical experience in this subject.

* Paper read before the Iron and Steel Institute Meeting, Buxton.

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The question of the cost of applying this process, which must be considered before all others, is more difficult to discuss generally, owing to the great variety of conditions. The following are the chief points, all of which must be carefully considered in each particular case :—

(1) The possibility of saving in cost of raw materials, since the best qualities of steel can be made from impure raw materials. For example, in the case of refining steel from open-hearth furnaces in the South Staffordshire district, the use of local pig iron, as compared with hæmatite iron, would effect a saving of several shillings per ton owing to the high railway rates.

(2) Possibility of increasing the output of present furnaces by the addition of electric furnaces with improvement of product. For example, in the case of Talbot and other open-hearth furnaces, where a large expense is incurred in the removal of sulphur and getting a teeming heat, the steel can be advantageously transferred to an electric furnace for desulphurisation and the output materially increased. The Talbot or other tilting furnace is especially satisfactory owing to the facility with which charges can be transferred to the electric furnace, whenever required.

(3) The cost of power and possibility of using blast-furnace or coke-oven gas, exhaust steam, etc., will be the determining factor in regard to deciding whether, in the manufacture of steel, electric refining can be economically adopted. In the case of cheap power or valuable products, scrap may be economically melted and refined in the electric furnace at a current consumption of 700 to 800 kw. hours per ton, or if the price of power be high, the steel may be merely desulphurised and deoxidised, after melting and dephosphorising in a basic furnace with a power consumption of 100 to 150 kw. hours per ton.

(4) The possible reduction of capital expenditure at certain works where the present products are not sufficiently good for modern specifications. This may involve the entire re-organisation of the works, but it is often cheaper and more efficient to add an electric furnace to a Bessemer plant, than to replace the latter by open-hearth furnaces.

The author does not wish to compare the different types of electric furnace in this paper, but the figures given are taken chiefly from Heroult furnaces in America, England, Germany and France, as this type has been far more widely adopted, and is used in larger units than any other, and single furnaces are now refining 250 tons per day. This furnace is similar to a basic open-hearth furnace, and seems to present more simplicity and to embody more of the desirable features of electric furnace design than any other, which, in the author's opinion, are :—

(1) The best basic open-hearth design should be followed as closely as possible. A bottom homogeneous and solid and banks free from embedded electrodes is important, and, above all, simplicity of design.

(2) All electric mechanism, in the form of generators, transformers, etc., should be entirely separate from the furnace, should work under ordinary conditions of standard electrical practice, and should be of standard design, so as to avoid all unnecessary risks and complications.

(3) A high-power factor must be maintained, thus reducing the capital cost of machinery, and increasing the general efficiency of the power-house.

(4) To avoid excessive cost of refractory materials, the roof should be protected from the direct radiation of the arcs by the electrodes themselves, and the intensely heated area of slag should be as large as possible, to increase the surface of refining action. The Heroult furnace has an advantage over the open-hearth furnace in that the heat is applied to the centre of the bath, so that the banks are not quite so hot as the middle of the furnace and the wear of refractories is consequently less.

(5) The heat should be applied to the slag, as in the basic open-hearth furnace, and the temperature of the slag should be maintained above that of the steel, which allows of extreme basicity and fluidity being obtained and gives an intensely active refining action. The conditions in the furnace should be oxidising, neutral or reducing, at will.

The adoption of electric refining will cause some re-adjustment in the steel trade. As soon as the Sheffield steel-melter has become acquainted with the process, and accustomed to the working of electric furnaces, electrically refined steel will largely replace ordinary crucible steel. This has already occurred in Germany and America, where electric furnaces are used to make all classes of special and high-speed steels, the usual practice being to refine metal from a basic open-hearth furnace. Large crucible plants and small open-hearth furnaces engaged in the manufacture of small and intricate castings, such as motor-car parts, etc., may be replaced by electric furnaces, because the high degree of fluidity and dead melt obtained is especially advantageous.

In many cases manufacturers of axles, guns and tubes will abandon the use of Swedish raw materials, and refine steel made from low-grade ores, thus reducing the value of high-grade ore deposits and the quantity imported; for, by the use of electricity, Cleveland stone will produce a steel equal to the best hæmatite ores. The capacity of many Talbot and basic open-hearth plants will be increased and the quality of the product improved, while much of the power that is now going to waste will be utilised for steel refining.

From the electrical engineer's point of view, the electric furnace is an attractive load, as it is more or less in continuous operation. In the case of the Heroult furnace the power factor is 0·88 to 0·90, though much less with large induction furnaces. Single, two or three-phase current of any frequency from 20 to 60 has been used without any difficulty, though it is preferable in the case of a two-phase system to transform to three-phase current, which can be done without additional difficulty or expense. The load factor will be most favourable, the usual practice when refining, for example, in a 15-ton furnace, being to use 2,000 kws. for 20 minutes after charging, while the steel is being heated. The current is then reduced to about 1,500 kws. for 45 to 75 minutes until the steel is ready for teeming. There is then an interval of 10 to 15 minutes during which the furnace is teemed, fettled, and charged, which allows the transformers or generators time to cool before the period of overload commences. Current fluctuations occur for a few minutes, while there is an evolution of gas from the steel which makes the bath boil up and touch the electrodes. This, however, is not sufficient to be objectionable, provided that the electrical machinery is properly designed for the purpose, and the extent of these variations is not so great as in the case of many rolling-mills, the fluctuations in voltage being only about 3% in the South Chicago works, where a 2,000 kw. furnace has been working steadily since May, 1909.

The subject of electric steel refining is now receiving the attention of many steel-makers, and it is hoped that these notes may lead to a stimulating discussion, not only of the many interesting and debatable questions in relation to the operation and design of these furnaces, but also of the more important and far-reaching economic and commercial problems which this process has created.

Discussion.

Mr. E. H. Saniter (Rotherham), while he had a considerable belief in the future of the electric furnace in certain directions, thought the future would be damaged by the furnace being recommended for the making of comparatively cheap qualities of steel, because people would find that the steel was not sufficiently improved to pay for the extra cost. He agreed that rails were not likely to be generally manufactured from the electric furnace at present. Even under the special circumstances at South Chicago, he was inclined to doubt whether the process would be continued. He believed they turned out something like 2,000 tons of rails in 24 hours. If the present furnace was such a brilliant success, why did they not have another dozen, and produce all their rails by its means? There might be a saving in raw materials, but he did not think that any possible saving between the price of hæmatite and of Cleveland pig would pay for running a duplex process, which included the electric furnace. It was time they had some more definite information on the

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subject of costs. It had been interesting and amusing, during the last few years, to follow the various theories with reference to the desulphurising nature of the electric furnace. Mr. Campbell gave the credit to the calcium carbide, but nobody ever mentioned the fluorspar, which took the sulphur out of both the electric furnace and the basic open hearth. He (the speaker) doubted whether calcium carbide had anything to do with it.

Mr. E. C. IBBOTSON (Sheffield) said many of the points mentioned by Mr. Campbell applied equally to the induction furnace. It was a question whether the arc furnaces, with their intensely hot areas, would not seriously affect the high-carbon steels such as were produced very carefully in Sheffield. The question of scorching ingots, and of the control of heat, was very important for these classes of steel.

Mr. J. H. HEAP (London) said they could not give a simple "Yes or No" answer to the question of whether steel could be made better or cheaper in the electric furnace. The general answer was, probably, that the more coke or coal was used, as fuel simply, the better did electric smelting compete with the other processes. In fine crucible steel they had an expenditure on coke, as fuel simply, of 60s. to 70s. per ton of steel produced. If they took the consumption of electricity as 800 kw. hours per ton, it would cost them, at a halfpenny per unit, 33s. 4d., so that they had a great margin, which was only slightly reduced by the cost of electrodes, etc. At the other end of the scale, for pig iron they had a consumption of 2,000 kw. hours per ton, costing nearly 84s., and this only represented a part of the coke, because they must still use the latter as a reducing agent. Between these two extremes there were intermediate stages at which the electric furnace could be economically introduced. In considering its application in place of crucibles, they must remember that they were limiting it to the conditions of the crucibles, and assuming that it would be working with the same pure materials; whereas, when they came to review the question all round, they recognised that it could start with cheaper material. An obvious application for the furnace was that of refining common Bessemer steel. In view of the importance of the subject of the electric furnace, he suggested that it should be officially considered by the Institute.

Mr. T. ROWLANDS (Sheffield) thought it would be more correct to state that the South Chicago works were experimenting with the Heroult furnace than that they had adopted it. He wished for information as to the cost of electrodes for the large-size furnaces. He understood that there had been considerable trouble with the carbon electrodes, and that graphite electrodes, costing 15 or 16 cents a pound were being used.

Mr. F. W. HARBORD (London) declared that, from an economical point of view, the electric furnace could easily compete with the crucible. The next question was whether the quality of the product was equal and he thought it must now be admitted that for practical purposes it was so. There might be some very special classes of steel which could only be produced from very carefully selected materials melted in a crucible, but for 90% of the purposes for which tool steel was required, electric steel, made by any of the well-known furnaces, met all the conditions. In the making of axles and tyres, too, there was a great opening for the electric furnace. It was a dear melter, but an economical refiner at high temperatures. It was useful in the making of moderately high-priced materials, very low in sulphur and phosphorus, but he did not think that, generally speaking, it could be applied to rail steel.

Mr. CAMPBELL, in reply, agreed that the making of rail steel at South Chicago might certainly be regarded as experimental. The work started in May, 1909, and several thousand tons of rails were made for the New York Central Railroad, but until they had had a year's test it could not be decided whether the electric furnace should be used on a very large scale or not. In the meantime, it was being used chiefly for axles, tyres, and castings, with very satisfactory results. He only said that calcium carbide might combine with sulphur to form calcium sulphide. He did not know where the sulphur went to. He fully appreciated the importance of fluor spar, and always used it. He explained that the words "Sheffield trade" in his paper ought to have been written in italics. He referred to what was generally known as "Sheffield trade" outside Sheffield. A large amount of steel went into Sheffield for the Sheffield trade, and it was this intermediate quality, which was made into drill steel, and so on, that he meant—Swedish Bessemer and that class of material, which was manufactured in Sheffield, but not made there. As to whether the electric furnace would displace the crucible furnace entirely, he said "No." He quite agreed that there were special cases where crucible steel would always hold its own, but there was a lot of steel made in Sheffield that could advantageously be made in the electric furnace.

MAGNETIC AND NON-MAGNETIC ALLOYS.*

By A. D. Ross.

The author described certain magnetic tests which had been carried out on alloys belonging to the following ternary systems:—(1) Copper-manganese-aluminium; (2) copper-manganese-tin; (3) copper-manganese-antimony; (4) copper-manganese-bismuth, the object being to ascertain the magnetic properties of the various intermetallic compounds formed. In the case of the first two systems several members of the group were prepared and tested, so that the effects produced by thermal treatment and their variation with the composition of the alloy might be fully studied. In the two latter cases the object of the tests was merely to compare in a general manner the properties of these systems with the two former ones. One or two castings accordingly sufficed for the purpose. The binary groups tested comprised the following:—(1) Copper-manganese; (2) copper-aluminium; (3) manganese-antimony; (4) manganese-boron. In the preparation of the ternary alloys, the plan adopted was first to make a manganese-copper alloy, and then to add the third metal. As a rule the manganese-copper was composed of these elements in the weight ratio of 3 : 7, that ratio giving the alloy of lowest melting-point in the binary system (about 870 deg. C.). In this way there was little or no loss through volatilization, etc., on adding the third constituent. The alloy was cast vertically in the form of cylindrical rods about 9 in. long and $\frac{5}{16}$ in. in diameter. The binary alloys were prepared in much the same way, except that the majority of them, being too feebly magnetic to test by the usual methods, were cast as small rods measuring about $4\frac{1}{2}$ in. by $\frac{1}{4}$ in., and were tested between the poles of a powerful electro-magnet. These bars were in all cases sufficiently long to allow a small piece to be cut off the lower end and rejected, and two further portions—one from either end—to be taken for chemical analysis, leaving a rod of suitable dimensions for the magnetic test. The programme of the magnetic tests on the ternary alloys was to determine the magnetic quality of the alloys in the condition as cast; to find the simplest and most efficient heat treatment for bringing the alloys into a stable condition with the highest possible magnetic quality; to investigate the changes produced in the magnetic properties by exposure of the alloys to different temperatures, and incidentally to determine the critical temperature and investigate the reversibility of the thermal treatment; and to examine the effects produced by quenching, annealing, and baking the alloys. The tests were carried out on a magnetometer specially designed by Dr. J. G. Gray and the author for investigations of this kind. The alloy containing 62 per cent. copper, 25 per cent. manganese, and 12·5 per cent. aluminium was by far the most strongly magnetic, and that consisting of 43·4 per cent. copper, 18·1 per cent. manganese, and 40 per cent. tin was the least. These alloys were first of all tested as cast, that was without any preliminary dressing operations. Tests were made with the material (1) at room temperature, and (2) when cooled down to —190° C. For the latter test the specimen was placed in a glass tube, one end of which was closed while the other was open and curved upwards. The tube was supported by cork bungs so that the specimen lay along the axis of the magnetizing solenoid. Liquid air was poured

* Abstract of paper read before the Institute of Metals.

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into the glass tube, and a steady temperature was soon attained. The results obtained with these alloys at 15° and —190° C. were as follows :—

Applied Field.	Intensity of Magnetization.			
	Cu+Mn+Al.		Cu+Mn+Sn.	
	15 deg.	— 190 deg	15 deg.	— 190 deg.
20 ..	254	300	21	21
50 ..	292	358	53	53
100 ..	310	388	95	95
200 ..	324	401	159	160
Residual ..	85	160	11	11

Experiments made on copper-manganese-antimony alloys showed them to have properties which were very similar to those of the copper-manganese-aluminium alloys. The bismuth bronzes, however, differed in one or two important particulars from the others. The fact that these metals were ferro-magnetic at all was rather remarkable when the nature of the constituent elements was considered. Manganese was only very feebly paramagnetic, while copper was slightly, and bismuth comparatively strongly diamagnetic. Those elements nevertheless combined to give alloys with decidedly ferromagnetic properties. Tests had been made on the binary alloys, copper-manganese, copper-aluminium, manganese-antimony, and manganese-boron, with two objects in view—(1.) to ascertain their susceptibility to magnetization; and (2.) in the case of the Cu+Mn and Cu+Al groups to compare their behaviour upon quenching, cooling to —190° C., with that of the ternary alloys. The Mn+Sb group was the more magnetic, alloys approximating in composition to the formula Mn_3Sb_2 being, comparatively speaking, fairly susceptible. Alloys that corresponded roughly with the formula Mn_2Sb were less magnetic, somewhat more retentive, and had much greater coercive force. A manganese-boron alloy containing equal atomic proportions of the two elements was about as magnetic as Mn_2Sb, and exhibited much the same hysteresis. Owing to the impossibility of obtaining castings free from blow-holes, no attempt was made to measure the absolute values of the permeability of those materials. The copper-manganese and copper-aluminium alloys were so feebly magnetic that it was not practicable to test them magnetically in the usual way. Short bars of the metal were placed in the narrow pole gap of a powerful electro-magnet in a field of nearly 5,000 gauss, and the residual magnetism of the specimen was thereafter tested by a delicate magnetometer. Copper manganese, containing about 30 per cent. of manganese, was found to be more retentive after quenching than in the cast condition. It thus differed essentially in magnetic properties from the manganese-aluminium and manganese-tin bronzes. On the other hand, an alloy containing about 10 per cent. aluminium and 90 per cent. copper gave effects very similar to those in the copper-manganese-aluminium alloys, viz., an improvement on cooling to liquid air temperature and a deterioration on quenching. A few other copper-aluminium alloys with widely varying compositions were tested, but the others did not show the same similarity to the ternary alloys. It might be asked why solid solutions of Mn or Mn_3Al in Cu_3Al should result in the production of a material so much more magnetic than either of its constitutents. No direct explanation could be given at present, but these were analogous instances. Thus the addition of small quantities of aluminium and other elements to iron with the formation of solid solutions led to material more magnetic than iron, although the added element itself was non-magnetic. Again, copper-aluminium alloys containing aluminium in increasing proportions up to 8 per cent. consisted of solid solutions which were the more retentive of magnetism the greater the amount of aluminium present. Why the presence of a non-magnetic constituent should enhance the magnetic quality of a material was a difficult question to answer. Perhaps the action was somewhat similar to that in which nickel and other allied elements altered the recalescence point Ar_2, at which iron transformed from the non-magnetic to the magnetic condition. The solution of the problem would be of great interest alike to physicists and metallurgists, and it seemed probable that satisfactory progress was most likely to be attained by extensive magnetic tests on alloys conducted in combination with metallographic investigation.

Discussion.

Dr. H. C. H. Carpenter noted that all the alloys investigated by Mr. Ross which showed full magnetic properties contained manganese, which itself always contained a certain amount of iron, and the point arose as to the influence exerted by the iron.

Professor Gray pointed out that manganese steel which was supposed to be highly non-magnetic could be made very magnetic by proper treatment. Reference had been made by Dr. Carpenter to the presence of iron in the manganese, and it was an extraordinary fact that a small quantity of iron caused effects far greater than would have been supposed.

Mr. E. L. Rhead, in giving the results of a research designed to investigate the effect of adding various metals to manganese, said that the most remarkable effects were obtained with antimony and bismuth, and much the same effects regarding magnetic properties, though not to the same extent, were secured by the phosphorus and arsenic group.

Mr. J. S. G. Primrose referred to the discovery by Dr. Rosenhain that alloys which he had found to be magnetic grouped themselves by their structure appearance.

HYGIENIC ASPECTS OF ILLUMINATION.*

By Leon Gaster.

(*Delegate of the Illuminating Engineering Society.*)

Public attention has of late years been drawn to the importance of the hygienic conditions under which industries are carried on and the prevention of industrial maladies. Good ventilation, good air, and adequate sanitation are now regarded as essential conditions for the preservation of health of employees in factories and workshops, and good illumination, it may be suggested, is every whit as vital.

Moreover, not only the workman, but also the employer benefits by the maintenance of good lighting conditions, for the expense involved in making the necessary improvements isusually trifling in comparison with the better quality and greater output of work which would result. This is now well recognized, and there is a widespread desire for more definite recommendations on the subject of factory lighting. America and the chief countries of Europe have recently been devoting special attention to the matter. For example, efficient lighting is required in general by the Factory Acts of France, Germany, Switzerland, and the United States. In Holland the employment of women and young children is even forbidden in works in which artificial lighting is normally required between 9 a.m. and 3 p.m. In addition, an illumination of about 1·5 foot-candles is specified as the minimum for certain processes exceptionally trying to the eyes, such as embroidery, engraving, jewellery, draughtsmanship, knitting, quilting, etc., and a minimum of 1 foot-candle in other less exacting occupations. Moreover, it is stated that a special bill relating to the control of industrial lighting generally is also being prepared for introduction into the New York State Legislature.

There is, therefore, good precedent for the view taken by the Home Office in this country as to the importance of this matter. H.M. Chief Inspector of Factories in Great Britain, in his annual report for 1909, laid special stress on the need for good lighting conditions. "The importance of adequate lighting," he said, "is obvious. On the health side it is hardly necessary to point out that inefficient illumination entails risk, strain, and ultimate damage to the sight, or that it tends to neglect of cleanliness and adds to the risk of working in poisonous materials." Dr. T. M. Legge, Chief Medical Officer of the Factory Department of the Home Office, has laid stress on the value of good lighting conditions, especially abundance of daylight, as a preventative in those trades which tend to give rise to tuberculosis, and as a means of combating consumption.

The Home Office are now making a special study of the question of conditions of illumination in factories, and are providing for the collection of data bearing thereon.

* Abstract of paper presented at the Second Congres International des Maladies Professionelles, Brussels, September, 1910.

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In attempting to deal with illumination, we must remember that good results can only be secured by the joint efforts of the engineer, the oculist, and the architect. The whole question of illumination depends upon the behaviour and well-being of the eye, and the medical profession are, therefore, intimately concerned.

At the same time, new developments are constantly taking place, and newer and brighter sources, with the technical details of which the engineer is chiefly familiar, are replacing the old lights of the past. In one respect these new sources are notably different from the lamps they are superseding. The "intrinsic brilliancy" or "candle-power per square inch" is much greater, and the lights are therefore apt, if misused, to be dazzling to the eye. For this reason it is most essential to arrange the sources wisely, so as to avoid any tendency to glare, and especially in the case of workshops and factories where people are exposed to artificial light for long periods of time. Lights should therefore be placed outside the direct range of vision, and advantage should be taken of appropriate shades and reflectors so as to direct the light where it is wanted and to screen it in directions in which its brilliancy would be inconvenient.

Again, there are many industrial processes, such as those which take place in lamp factories, glass and iron works, welding operations, etc., where workers may be exposed to the rays of these bright illuminants, and proper methods of protection are most important. But it has been suggested that it is not only the intrinsic brilliancy that is harmful. Dr. Stockhausen and others have laid stress on the effect on the eyes of the ultra-violet invisible rays, and attributed the severe inflammation following incautious exposure to powerful lights to this cause; this question requires further examination before definite recommendations can be made.

It has also been suggested that the prevalence of cataract among glassworkers is due to the peculiar radiation given out by the molten material, and an inquiry is now being conducted into the matter.

Yet another aspect of the subject which deserves to be emphasized is the tendency of bad conditions of illumination to lead to accidents. Naturally, mishaps are more apt to occur when the machinery cannot be clearly seen, and it is to be noted that the Fidelity and Casualty Co., of New York, in a recent report placed defective lighting first in the list of causes of accident.

Much has also to be learned concerning the degree of illumination required for different purposes, not only as regards factory lighting, but also in libraries, schools, and other public buildings. In Holland, as mentioned previously, legislation already prescribes a minimum order of illumination for certain classes of work, and similar recommendations are also being considered in other countries.

It may be added that international co-operation is very desirable in order to secure general agreement as to methods of measuring and expressing illumination. During the last year an important step was taken in the adoption by France, Great Britain, and the United States of a common unit of light, but we are still in want of a similar agreement regarding the unit of illumination. In order to be able to specify exactly the conditions of illumination it is essential that the measurement of illumination should come to be generally practised and regarded as a reliable and practicable process. Considerable progress has recently been made in the improvement and simplification of apparatus for this purpose.

This furnishes one more illustration of the need for co-operation between engineers, architects, and the medical profession. The engineer ought to bear in mind the views of the oculist, school and factory inspectors, medical officers of health, etc., as to what constitutes hygienic illumination. They in turn could benefit by the methods of precise measurement contrived by the lighting engineer.

It is only by the co-operation of these different experts that the questions which are now arising in connection with illumination—questions of great public and industrial importance—can be adequately studied, and the Illuminating Engineering Society was formed in London last year with the object of bringing together these different experts and providing for the collection of the needed data on the subject.

In order to facilitate the exchange of views of experts of different nations on these matters the Illuminating Engineering Society has also been organized on an international basis, and has among its corresponding members authorities in different parts of the world.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

QUESTIONS.

Question No. 1228.—Describe the working and give diagram of connections of two-wire continuous current generator with static balancing transformer. How does this arrangement compare as regards cost and efficiency with the ordinary generator connected across outers, middle wire being derived from separate rotary balancer.—"W. A. E. M."

Question No. 1229.—It is proposed to warm a small church by electric radiators. The floor area is 70 ft. by 25 ft., height 22 ft. What will be the consumption of electricity and the best type of radiators, and arrangement of same, for the purpose?—"H. W."

ANSWERS.

Question No. 1225.—In starting up a 50 h.p. squirrel-cage motor (3-phase, 400 volts, 50 ~) by an auto-starter the rush of current is so large as to lower all the lighting on the generator. Is there any cheaper way (besides slip rings) of getting over this trouble.

Reply to Question No. 1225 (*awarded* 10s.).—A wound rotor with slip-rings and resistances would undoubtedly be the most satisfactory arrangement; even the best designed induction motors, with squirrel-cage rotors, take at least 25% over full load current in order to give their maximum torque at starting, However, as the question precludes a slip-ring rotor we will consider other methods of reducing the starting current to a minimum.

Rotors have been made without slip-rings and provided with resistances forming part of the rotor itself, a lever, or hand-wheel, being arranged so that the operator can cut out resistance as speed increases. Another method is to utilise centrifugal force, the resistances being cut out automatically at a pre-arranged speed of rotation. Rotors are sometimes fitted with two windings; one of high resistance for starting up, the other cut in when full speed is attained. With a squirrel-cage rotor the end rings may be made to have a comparatively high resistance; this, however, has the great disadvantage that although the starting current is reduced and the torque is improved, there is a proportionate addition to the permanent C^2R losses. These different arrangements are quite special and cannot be said to represent everyday practice; they tend to complication and thus rob the squirrel-cage induction motor of its strongest point—simplicity.

The low starting torque with induction motors generally, and those with squirrel-cage rotors in particular, is partly due to the large rush of current when motor is started up from rest, that is when the slip is a maximum. This heavy current weakens the field due to the stator; therefore, since torque is the result of current in the rotor conductors and the field in which they are placed there may be a reduced instead of an increased torque by the rotor. Again when the slip is a maximum, the periodicity of the current in rotor conductors is also a maximum; with the low resistance of the rotor conductors the inductance of the winding causes the time constant to be very appreciable,

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hus giving rise to differential action by the rotor conductors. Therefore, although the rotor conductors may be carrying large currents they do not all tend to turn the rotor in the same direction. With a wound slip-ring rotor, the resistance added by the starter not only reduces the current but also the time constant of the rotor circuits.

Although probably rather an expensive proceeding, it might be advisable to compound the alternator.

Before making any great electrical changes it will be as well to overhaul the mechanical arrangements. Perhaps some improvement may be effected with the load, so that starting up may be made easier. It sometimes happens that machines are left on instead of being thrown off the tight pulley. Again, where there is a lot of belting the belts may be so tight and in such bad condition that starting from rest requires an abnormally large effort. The writer some time ago had a somewhat similar case. In a machine shop it was the practice to leave a number of the machines "on," the shafting was in a very indifferent condition and was oiled—sometimes. The belts were mostly thick and clumsy and as tight as fiddle-strings. The consequence was that the motor usually started up on a load three-fourths of its maximum. When the mechanical conditions were improved there was not much difficulty with the motor.

It would be worth while to rig up a temporary arrangement to try if another auto-transformer would cure the trouble; an extra set of tappings might be all that is required.—"M. M."

LARGEST ELECTRIC CLOCK.

Big Ben is, it appears, no longer to have the proud position of being the biggest clock in the world. We learn that Messrs. Gent & Company, Ltd., of Faraday Works, Leicester, have an exceptionally interseting contract on hand at the moment. It concerns the electric clock now being built for the Royal Liver Insurance Company's new offices at Liverpool, and this when completed will be the largest in the world, *vice* Big Ben, deposed. Its proportions are certainly colossal, and a glance at the following dimensions will convey some slight idea of its enormous size.

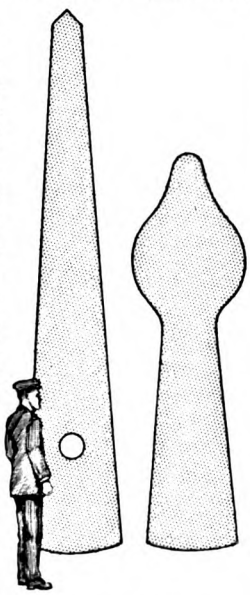
To actually realise its proportions it has been necessary to turn the end wall of Messrs. Gent's factory into a provisional drawing broad.

The clock possesses four dials and will be placed in a tower about 220 feet above ground level.

Each dial measures 25 feet in diameter, and the minute hands measure 14 feet long and 3 feet at its greatest width.

Each of the huge hands is made of copper with 9-inch gun metal ribs, and they are being constructed of ample strength to withstand the wind pressure in the necessarily exposed position.

To safeguard against the very worst conceivable efforts of the elements, storm, wind, rain, etc., it has been necessary to design the dials to withstand a pressure far in excess of the greatest force ever likely to be met with; the importance of this will be appreciated when it is realised that an ordinary gale will produce a total pressure of 11½ tons on a dial.



HOUR AND MINUTE HANDS.

Each of the dials is cast in several pieces to facilitate manufacture, transmission and erection, and the white groundwork of the dials will be special translucent opal glass, which, although only one-eighth of an inch thick, has been shown on test to be capable of withstanding a pressure of 600 lbs. per square foot without breaking.

The hours are indicated by twelve distinctive marks, instead of the usual Roman characters; each of these marks measures 3 feet by 1 foot 6 inches, and 1 foot 2 inches separates each of the minute marks. Thus it will be seen that the circumference of the actual clock face at the "minutes" is no less than 70 feet.

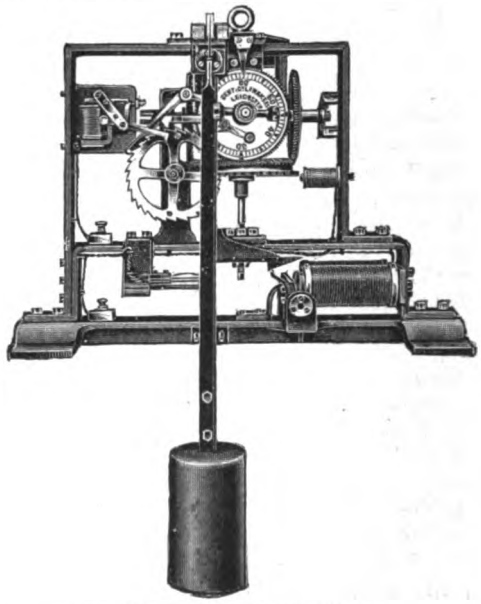
The "waiting-train" movement, invented by Messrs. Gent (which has come to the front so much of recent years) is employed to drive and to control the progress of the hands. This movement, we may add, is the very essence of simplicity. The hands will not move forward in half-minute impulses, as one is accustomed to see with ordinary electric clocks, but with a practically continuous motion, and will be governed by a precision Time Transmitter designed by Messrs. Gent which is now being largely used in observatories in this country and abroad.

The "waiting-train" movement referred to is a reciprocating slow speed motor, the duty of which is to rotate the hands only, the timekeeping being effected by the precision Time Transmitter mentioned above, which brings the "waiting-train" movement under control at each half-minute, the accuracy of the timekeeping of the largest clock being thus assured.

One of the advantages of this system of timekeeping is entire dis-association of the timekeeping element of the clock from the hand-driving element, with the very desirable result that the effect of the weather on the hands cannot react on the timekeeping, as it is often found to occur with the ordinary mechanical clock.

Another advantage of the system referred to is that a number of smaller clocks can be distributed throughout adjoining premises and be driven from the same transmitter, the whole keeping the same good time.

The transmitter will be connected through the G.P.O. wires to Greenwich and will become automatically corrected when necessary, with the result that the clocks will indicate Greenwich Mean Time.



"WAITING TRAIN" MOVEMENT.

The dials of this large clock will be electrically illuminated, and a very ingenious apparatus is being made which will automatically switch on the light at dusk and switch it off at dawn. The time, however, of lighting up varies with the seasons, being from 4.20 p.m. in the winter to 10 p.m. in the summer, with an equal variation of time for the switching off. Seeing that with the "waiting train" movement there is no longer need to ascend the tower for the purpose of winding, it would necessitate special attention each week to re-adjust the times of switching off and lighting up.

By an ingeniously-arranged cam, however, mounted within the switching apparatus, the times of lighting and extinguishing are altered to suit the seasons automatically, the cam effecting this by a simple reducing gear, revolving once only in two years. The error due to Leap Years is compensated so nearly that the error remaining is only 10 minutes in 30 years, and at the end of this period it can be corrected and reset for a subsequent period of 30 years in less than one minute, and without the use of tools.

The accompanying illustration shows an average man standing alongside the hands, and will convey to the reader some idea of the size of this large clock.

It is gratifying to know that in keeping with the rapid progress of modern science, the largest clock in this country will be electrically driven, showing that England is by no means behind other countries in the application of electricity to the Arts.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

The mania for striking is still in full swing on Tyneside. Undeterred by the terrible object lesson of the boiler-makers' lockout—caused by injudicious sectional strikes—which is every day involving fresh sections of the industrial community in misery and paralysing general trade, other sections of workers are going on strike to ventilate real or fancied grievances. The latest phase of this obsession is the strike of apprentices which is now proceeding at two firms well known to electrical engineers—Messrs. Palmers', of Jarrow, and Messrs. Clarke Chapman, of Gateshead. In the former case the strike appears to be directed against a new system of time checks in place of the old time-boards for recording the hours spent on any job, a system which one would have imagined would have been put out of existence with thanks by the workers. In the second case it is extremely difficult to determine accurately what reason exists for the irregularity. One result, however, has been that men with families to keep have been thrown out of work through the dislocation caused by the apprentices' strike.

Marine Work.

In this connection, it is interesting to note an announcement in the "North Mail" that the repair of the s.s. "Wisbeach," belonging to a Newcastle firm which has hitherto placed its repair work on the Tyne or Blyth, has been sent to the Mersey for repairs, which will cost about £4,000. This loss to the district is directly attributable to the shipbuilding dispute, and as Tyneside ship repairing firms are good friends of electric power supply and afford a market for electrical contractors, this loss, which is typical, should not pass unnoticed. About the only cheering news in this department is that Messrs. Smiths' Dock Company, Ltd., have commenced the construction of a new dry dock of large dimensions at North Shields, which is to be 530 ft. long and over 70 ft. wide. Mr. J. M. Moncrieff is the consulting engineer, and Messrs. Sir John Aird & Company the contractors. In the existing docks electricity is extensively used, so that there is here an opening for further electrical plant for pumping, etc.

Architectural and Civil Engineering Works.

On October 19 it is proposed to formally open the new municipal buildings at South Shields, which have been designed on an ample scale to meet the growing needs of that borough. The buildings are of an extremely handsome appearance, and electricity from the municipal electricity department has been lavishly used for illuminating purposes. It is interesting to note in this connection that the Newcastle Council are again considering the question of building a new Town Hall, a very necessary procedure, in view of the character of the present building. In a recent discussion of the question by the Corporation New Town Hall Committee, it was decided that the site now occupied by the Northumberland Baths in Northumberland Road would be a suitable situation, and it was decided to confer with the Estate and Property Committee regarding the question. Another interesting development in this area is the re-construction which is now being carried on by the North-Eastern Railway of their station at Whitley Bay. This involves the construction of new platform and railway buildings and the demolition of certain houses. As this station is upon the electrified portion of the railway, it may be taken for granted that electric power and lighting will be largely in evidence in the new station, which will be of large dimensions.

Tramway Matters.

Relations are still somewhat strained between the men employed on the Newcastle Corporation Tramways and the Committee. The latter are prepared to receive a deputation of five employees and one official of the Tramwaymen's Association in order to discuss grievances, but decline to receive Mr. Tate, the secretary of the Association, until he withdraws certain statements regarding the Committee. The men appear to regard this as an attempt to undermine Trades Unionism, and a meeting of the City and District Tramway Workers' Union has voted a protest, and asked the Committee to cancel their decision not to meet the secretary and chairman of the Union. It is to be hoped that these differences will be settled amicably. In the meantime, development work is proceeding; one piece of work which has just been put in hand being a contract to Messrs. Edgar Allen & Company for a tramway junction linking up the Spital Tongues and Fenham routes.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The Birmingham and District Electric Club will open its session this week by a smoking concert on Saturday evening at the Colonnade Hotel, when the President, Mr. G. O. Donovan, M.I.E.E., will take the chair. The winter arrangements will include, besides the reading of papers, a number of interesting social engagements.

Colliery Managers and Electricity.

The growing importance of electricity as an adjunct to mining is illustrated by the fact that although there is in the district a branch of the Association of Mining Electrical Engineers, it was thought desirable to have a discussion upon "Electric Haulage in Mines" at the meeting held in Birmingham on Saturday of the South Staffordshire, Warwickshire and Worcestershire Branch of the National Association of Colliery Managers. The subject was introduced by a paper from Mr. Arthur Hall, M.Inst.M.E. (President of the former Association). Mr. Hall being engaged on the Continent, the paper was presented by the President (Mr. D. E. Parry). Mr. Hall pointed out that owing to recent legislation compelling the restriction of coal mining hours, efficiency, economy and speed were becoming more and more vital. Again, owing to the present-day tendency to open out and work much larger areas of coal from one set of shafts than was the case formerly, efficient mains, as well as subsidiary haulage in collieries had now become imperative. Horse haulage on the main roads was becoming a thing of the past, though it was still common on the gate roads and levels. Systems of transmitting power from the surface by endless or single ropes, or by conveying steam or compressed air from a surface to engines below ground, were all more or less costly and inefficient, and these methods of driving, as well as the auxiliary horse haulage, were gradually and, in some districts, rapidly giving way to electrically driven systems.

Economy of Electricity.

It could not be denied, Mr. Hall admitted, that an electrical installation is primarily a somewhat heavy charge on a colliery, but, spread over a period of years, the resultant economies—always assuming that a good initial job was made—more than counterbalanced the extra outlay. A steam-engine when doing even its full amount of work, did not perform it very economically, and its maximum work was only about 25% over its rated horse-power, whilst its work if much over or under this was very uneconomical indeed. An electric motor could give an overload up to 100% for short periods and 50% for fairly long ones, without danger, very economically, and with a practically constant turning moment; whilst its efficiency was very little impaired when running on light roads.

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A.C. or D.C.

Without entering closely into the much discussed question of A.C. *versus* continuous current supply, which in the case of collieries must be decided by local conditions, Mr. Hall said that it was obvious that for transmission over long distances, the enormous difference in cost of cables decided at once in favour of high tension A.C. current in generation if not in application, but, apart from the question of distribution, the continuous current motor had a superiority even over a slip-ring A.C. machine where a heavy starting torque was required, as was the case in most colliery applications. This advantage balanced the disadvantage of commutator current collection. It must be remembered, too, that the designs of multipolar continuous current machinery had been vastly improved during the last few years.

Special Designing Necessary.

One of the most fruitful causes of breakdown in mining electrical machinery hitherto had been the failure of the makers to realise that such machinery needed to be specially designed for its particular duties. Working conditions underground were such that the machinery could not receive the attention that was given to such apparatus under ordinary industrial conditions. Electric mining machinery should be treated by makers as a separate class of work, and its design and construction should be the outcome of actual experience of colliery necessities. The considerations applied especially to the design of haulage gear. Motors, controllers, and other electrical accessories should be rated upon an unusually liberal basis. In the determination of mechanical proportions high factors of safety should be employed. Details should be manufactured and fitted with the greatest accuracy, and as little space as possible should be occupied by the motor and gear.

Some Points.

The frame or bed should be built up of rolled steel joists and channels, well braced, with plates, angles, etc. The frames should be such as to be easily taken apart to facilitate getting down the shaft and conveyance underground. It was also desirable to fasten the steel frames down to a foundation of timber baulks. In collieries liable to floor movements, either timber baulks, or steel joists placed above the floor and let into the sides or the bricks or other work, formed a good and safe carrying medium for the gear. For sizes up to 50 to 75 b.h.p., the first motion-gear could be a raw-hide pinion keyed on to the motor shaft and working to a cast-iron spur wheel, both having machine-cut teeth. For larger sizes, a mild steel pinion working into a cast steel wheel, both machine cut was more suitable. Some, however, preferred a cotton rope or other drive for large sizes. In any case, a motor speed exceeding 750 r.p.m. was not advisable. In sizes up to and including 25 b.h.p., the second-motion gear should be of cast iron, with machine-moulded teeth shrouded and turned to pitch line. The drums for the smaller sizes might be of cast-iron with mild steel lagging plates and gunmetal bushes. For the larger sizes, built-up drums were desirable, as combining lightness with strength. The shaft in all such cases should be of the best hammered steel machined all over. The bearing pedestals (of cast-iron) should be massive, and the bushes of gunmetal with large bearing surface. In endless haulage cast-iron bushes, by reason of the slower speed, were sufficient.

Motors.

The motor might be either of the enclosed ventilated type or of the totally enclosed type, as circumstances might require. For endless haulage it should be continuous rated; for main-and-tail and single drum haulage a rating upon an intermittent (say, one hour) basis was permissible. The motor winding might be either series, shunt, or compound. Shunt wound motors are, in Mr. Hall's opinion, unsuitable for main-and-tail or single drum (plain rope) haulage, but may be employed in the case of endless haulage fitted with gradual-acting clutch, or where the weight was fairly well balanced, compound wound motors are most useful. In deciding the size of the motor, a margin varying from 20% in the case of large motors, up to about 50% in the smaller ones, could be allowed, the relatively small difference in price being negligible as compared with the value of security against breakdown. A spare armature and field coil should be ordered with the rest of the plant, and it was best, if possible, to have a uniform—and, consequently, interchangeable—set of motors driving haulage. It would not then be necessary to keep so large a stock of spare parts. For main-and-tail and single-drum gear, controllers of the revolving drum of tramway type were most suitable. They should be so enclosed as to be practically dustproof, and—in fiery mines and where totally enclosed motors are used—plain type. Owing to the absence of Mr. Hall, the discussion of the paper was postponed.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

The lock-out in the Cotton Trade has been the subject occupying most minds during the past week. It naturally has a disturbing and depressing effect on business generally. Black as the outlook was, at the moment of going to press, there are signs of a settlement. Apart from strikes and lock-outs, labour returns show that unemployment is rapidly decreasing, pointing to a steady growth of business. That this is the case is also shown by the amount of overtime being worked by all the big firms. Perhaps the one branch of the local industry which is not really busy is cable-making; one firm in particular is complaining of the great difficulty in meeting foreign competition in this country, while it finds the building up of foreign trade quite impossible, except in one or two countries in the Far East. Writing of foreign trade, I understand that the enterprising local firms of motor manufacturers who established a branch office in Canada recently, are being well repaid for their trouble. The same thing may be said of other local firms who recently sent out representatives to establish agencies or branches in the Colonies. Their experience goes to prove that English firms can still get orders if they will only reach out for them, and that where the competition is international, rather than national, they can, with proper representation on the spot, meet local requirements at least as well as any of their foreign competitors.

Greater Manchester.

Now that the banding together of neighbouring towns under one local council has become a fact in the Birmingham district and in the Potteries, the old scheme, so often put forward before, of combining Manchester and Salford into one more or less respectable city, has been again resurrected. On the map the city and the Royal Borough lie together like a pair of kidneys, and for the most part are "separated" only by a few coloured stones let into the pavement of the numerous streets, which lie partly in Manchester and partly in Salford. This gives rise to considerable confusion and loss of time when a fire takes place on or near the boundaries, for the wrong brigade is usually summoned in the first instance. In the business district, the two towns are separated by the dirty little stream known as the Irwell, which is crossed by many bridges. From the electrical point of view the advantages of a joint supply under one department, and of a single tramway management are obvious. It was stated authoritatively some time ago that if amalgamation did become an accomplished fact the electricity undertakings and the tramways of the two towns would maintain to a great extent their independent character, at least for some time. If amalgamation took place now, however, it is very probable that as regards the electricity undertakings, these would be put under one department and linked up into one system. This would present no difficulty, for the D.C. voltages of both are now within 10% of one another, while in Salford the old 75 cycle single-phase lighting system is gradually disappearing. The Salford station is practically at its maximum output and a second station is under consideration, though it will be some little time before any steps can be taken towards building it. As part of one system, the additional load, and up to any amount, could be cheaply and efficiently supplied by extensions of Manchester's 6,600 volt three-phase mains

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in conjunction with tramway and private sub-stations, leaving the present Salford D.C. station for the local lighting, etc., requirements.

The I.E.E. Local Students.

The committee of the local I.E.E. students' section are now busy fixing the arrangements for next session. So far as has been arranged papers covering a very wide field, and chiefly on subjects hitherto little dealt with, either by the seniors or the students, have been accepted, and should provide excellent discussions. Owing to the poor attendances at visits last year, and to the fact that practically all the places of interest which would grant permission have already been seen, it is proposed this year to hold no visits. The committee will, however, consider suggestions as to works, etc., not hitherto visited. Owing to his having received an appointment with the Ordnance Electrical and Accessories Company, of Birmingham, Mr. L. H. A. Carr, M.S.C. Tech., who was holding the office of Hon. Secretary for the third time, has had to resign that position. He was most indefatigable in his efforts to make the section really useful to those members he represented, and in his work as Hon. Secretary he displayed considerable energy. He contributed three papers at various times, two of which gained second I.E.E. premiums, and were printed in the Journal. In the local Astronomical Society he was a leading light, and was always a star turn at the I.E.E. smokers. The students' committee made a small presentation to Mr. Carr as a token of their regard, and he also received a presentation from the staff at the Lancashire Dynamo & Motor Company, where he was engaged on design work. Mr. R. G. Parrott, 63, Northumberland-road, Old Trafford, Manchester, has been elected Hon. Secretary.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The Smoke Abatement Crusade is spreading like a religious revival. The first Annual Conference of the Smoke Abatement League of Great Britain was held in Glasgow on September 28, and besides the 70 members of the West of Scotland Branch of the league, there were present 30 English municipal delegates, 160 Scottish delegates, and two Irish. Much was said at the conference which has nothing to do with electricity supply. The Glasgow sanitary inspector was quoted as having said that 30 domestic chimneys were equal to one factory chimney so far as atmospheric pollution is concerned. The difficulty of getting up-to-date smokeless heat-producing devices in factories and tenements of dwelling houses resolved itself into the question of initial cost; it means capital expenditure to many small employers and property owners which they cannot afford. Speaking from the shopkeepers' point of view, Mr. A. H. Pettigrew, Glasgow, said that the fogs of last November cost the shopkeepers of Glasgow an aggregate amount of £100,000. The fog spoiled the goods, it cost a large amount for extra lighting, and it kept customers away. Dr. Magnus Maclean, of Glasgow Technical College, spoke of the advantages to be derived from the use of electricity for heating. He said he understood the Glasgow Corporation Electricity Department were shortly to give current for heating purposes to domestic consumers at 1d. per unit. The proposal was not to put in new wiring or new meters, but to find the average lighting consumption in each case and charge the excess where heat was used at 1d. per unit.

Glasgow Smoke Abatement Exhibition.

The above exhibition, which closes to-morrow (October 8), has been successful beyond the highest hopes of its promoters. The nature of the exhibits and the charge for admission except to ticket holders, has ensured that those visiting the exhibition were the class for whom it was intended. All the stall holders are agreed that throughout its three weeks' run the show has been patronised by the proper class of people. This has, no doubt, been effected, to a large extent, by the judicious distribution of admission tickets by the main promoters—the gas and electricity departments. The exhibition has certainly been a splendid advertisement for electricity, not only because of the excellence of the electrical exhibits, but on account of the atmospheric pollution within the exhibition, due to the large amount of gas heating and cooking apparatus continually pouring malodorous fumes into the air. The "Electric House" of the Electricity Department saved itself from this taint by its special system of ventilation giving a constant supply of fresh air direct from the outside into the various rooms of the house. The exhibition has been visited daily by about 4,000 people, including considerable contingents from the principal corporations in Scotland. In so far as direct business is concerned and the main purpose for which the show was promoted, it is recognised by all concerned that the results in the way of orders and the increased interest manifested by the public in the whole subject of smokeless heat more than justify the trouble and expense involved in getting the exhibition organised. The Beck Arc Lamp Company have received quite a number of good orders and many promising enquiries which are likely to materialise. The General Electric Company have many enquiries, but they naturally encourage retail customers to deal with contractors. Messrs. Primrose & Primrose are enthusiastic about the interest aroused by their stall, and are satisfied that a considerable amount of business has accrued already. Messrs. Malcolm & Allan, Drake & Gorham, Alexander Lindsay, British Westinghouse and B. T. H. Company have all done good business with clients visiting their stalls. The local press have devoted a large amount of space to the exhibition every day throughout its duration, and it is confidently anticipated that when the next exhibition of this kind is held, it will not be necessary to canvas local contractors to take space; it will be a case of making a selection from applicants anxious to show their wares. An interesting exhibit which was put up by the Electricity Department during the second week was a shop window filled with heavy dark tweeds, and lit in five different styles, viz., flame arcs, General Electric Company trough reflectors, inside the window, lamps with individual reflectors, "linolite," and "streetlite."

Paisley Electricity Department and the Local Tramways.

Mr. S. L. Pearce, chief engineer of the Manchester Corporation Electricity Department, has been called in to advise as to what the Paisley Corporation Electricity Department should charge the local tramway company for energy to drive their cars.

Electric Lighting at Cambuslang.

The Lanarkshire County Council, who have a small combined generating station and refuse destructor works at Cambuslang, have been approached by the Clyde Valley Electricity Supply Company, who suggest an arrangement for the mutual benefit of the council and the company, in accordance with which the company would take over the working of the undertaking. The Clerk to the Council has now been authorised to supply the Clyde Valley Company with whatever information may be necessary to enable them to submit a definite agreement. With gas at 2s. 11d. per 1,000 cubic feet in Cambuslang, and mains already laid for street lighting along all the drives, it should be a simple matter to rope in any number of good lighting consumers.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The importance of the selenium cell in telegraphing illustrations is well known, but it is also well known that the light falling upon it is to a considerable extent wasted by reflection from the electrodes and from selenium crystals. Gripenberg seems to have made an improvement which saves this. If such is the case, the commercial importance of his discovery can hardly be exaggerated. Herr Gripenberg makes a glass plate hold the electrodes by fusing into a gold or silver grating. The selenium is then laid on both sides. The edge of the plate being exposed to the source of light, is reflected by the selenium mirror and grating on each side of the plate on to the selenium and grating on

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the other side. The edge of the plate opposite to that exposed to the light is silvered so that none of the light entering the plate can escape without acting on the selenium. The resistance of the cell may be reduced from 30 to 6.

Softening Mica.

The hardness of mica varies considerably, and has much influence on its application to electrotechnics. As a rule the softer it is the better, but even the softest natural mica is too hard for some purposes, *e.g.*, for making insulating layers for commutator segments. Igniting the mica has been tried for softening it, and not altogether unsuccessfully, but has the great drawback of making the mica brittle, so that it may even break up during the process. It has now been found that if the mica is heated to a temperature below redness, and then suddenly cooled in water, it is softened sufficiently without losing its toughness.

Cable Boxes.

The safety cable boxes at present in use suffer from the disadvantage that new fuses cannot be placed in them during the passage of current without danger. Of course, shocks can be avoided if the workman wears india-rubber gloves, but there is still a great chance of bad burns if the new fuses are put in while the defects that caused the destruction of the old fuses are still in existence. The Siemens Schuckertwerke has constructed a new type of box in which all danger of whatever kind is avoided. The binding clamps and the collectors in this new box are fitted with contact springs in which a plug is inserted with the fuse. This arrangement has the advantage that the fuse can be put outside in the box in the dead plug. The plug is made of fireproof insulating material, and provided with a good handle. The plugs are connected with an arrangement whereby it can be seen the moment the box is opened which fuses have burnt out. These distributing boxes can be arranged for any number of cables.

Wireless for the German Army.

We have at last succeeded in evolving a motor car which is also a complete and up-to-date wireless telegraphy station, and "Automobil-Funken stationen" are to be supplied for the Imperial Cavalry and the Army staff. The new car has a crew of six men, who can erect the telescopic mast with its wires in a few minutes and earth it. The wires are then connected with the message-apparatus, and within six minutes after the car has stopped it is ready to both receive and transmit wireless messages over a radius of 100 miles.

Agricultural Electricity.

Harald Wallem publishes in the E.T.Z. some highly interesting data as to the consumption of power on electrically worked farms of 700 acres and upwards, and the results may be summed up in the following table: —

For lighting	from 0·6 to 1·0 kw. hours per	
For driving small motors	„ 1·0 to 1·5	700 acres per
For threshing	„ 2·5 to 3·0	annum.
For ploughing	„ 21·0 to 24·0	
Total ..	25·1 to 29·5	

Company Affairs.

Attention should one more be called to the great prosperity of the small German undertakings. The Elektrizitatswerk Westfalen A.G., with a capital of four million marks, may be taken as an example. It is paying 6% dividend for last year, as against 5% for the previous year. These concerns find a rich field in supplying outlying districts with current for any purpose that may be required. The net profit increased from 288,641 to 334,932 marks.

The Oberrheinische Kraftwerke A.G., of Mulhausen, has just been registered with a capital of 20 million marks, with the object of supplying current for general purposes to Alsass-Lothringen (Alsace-Lorraine) and Baden. The chairman is Dr. Martin Laas. The capital is divided into thousand mark shares, half of which are divided among the town of Mulhausen, the Elektrische Licht und Kraft A.G., of Berlin, Herr Justus Breul, and of Grunewald-Berlin, and the Bank fur elektrische Unternchmungen in Zurich.

A new Leipzig company has been founded with a capital of 360,000 marks, under the style of Kahle and Cless, G.m.b.H., Leipzig, for making electro-technical plant and apparatus.

The Elektrizitats-Aktiengesellschaft vorm Hermann Poge, Chemnitz, has declared a 7 per cent. dividend on the increased capital of one million marks.

The Hamburgische Elektrizitatswerke, Hamburg, have recovered during the financial year 1909-10 almost entirely from the unfavourable circumstances under which they laboured throughout the year before. Although the year just expired has to pay the first dividend on the four million marks of new capital, it will be able to do so without difficulty. The net profit has risen from 2,005,437 to 2,467,722 marks, and the output from 33,166,567 kw. hours to 35,676,154. It must not be forgotten that 854,400 marks have been paid out to buy land whereon to erect a new station, making five altogether.

This station is at Barmberk, and will be driven by eight steam turbines, each of 10,000 h.p. The dividend will be 8 per cent., and the debt to the town of Hamburg has been reduced from 1,300,000 to 588,729 marks.

The Rheinische Westfalisches Elektrizitatswerk, A.G., Essen a.d. Ruhr, has gone down slightly, the net profit having fallen from 2,810,004 to 2,670,974 marks, although the takings rose from 6,116,707 marks to 6,963,906. It is probable that the increased expenditure is only temporary, and is connected with negotiations which have practically secured for the company the supply of current to most of the Lower Rhine provinces for the next 30 years. Hence the raising of new capital will be necessary, and the districts to be supplied have decided to take up a large proportion of it. The dividend will be 8 per cent. on the capital of 30 million marks, as last year, while 133,743 marks will be carried to reserve, and 3,690 marks to new account.

At the annual general meeting of the A.E.G., to be held on October 15, 1910, a dividend of 14 per cent., as against 13 per cent. for the year 1908-9 will be proposed for 1909-10. The net profit arose from 16,384,571 to 18,425,225 marks. The capital is 100 million marks. The turnover in the first two months of the present financial year was 247 million marks as against 214 millions in the corresponding period of 1908-9.

An arrangement has been come to between the A. G. Brown, Boveri & Company, of Baden (Switzerland) and the Elektrizitats Gesellschaft Alioth, which has a capital of six million francs. The Brown, Boveri A.G. practically absorbs the other concern, giving its shareholders one new Brown Boveri share of 1,250 francs, nominal, bearing dividend from April, 1910, for every four preference or ordinary alioth shares of 500 francs, nominal, which acquired the right to dividend earning at the end of 1909. The existing factories at Monchenstein will be kept on. This amalgamation is only a part of a big combine engineered by the Brown, Boveri Company and the Swiss Bank Union. It includes the acquisition of the Isaria Zuhlerwerke A.G., of Munich, with a capital of 1,600,000 marks. The shares of this concern are exchanged by the shareholders for the new shares in Brown, Boveri & Company, share for share. The importance of all this for the development of the Brown, Boveri business is fairly obvious. The two transactions just mentioned required an extra capital for the Brown, Boveri Company of 6¼ million francs, but the board proposes to add eight millions to the present 20 million francs. The excess (1¾ million) will be taken over by a syndicate.

The Allgemeine Elektrizitatsgesellschaft, the Berlin A.E.G., in fact, made a net profit for the last financial year of 18,425,225 marks, just about two millions more than for the year before. The annual general meeting, to be held on October 15, will be asked to approve the declaration of a dividend of 14 per cent. as against the last dividend of 13 per cent. only, on the capital of 100 millions. Things are looking up with the A.E.G. The orders for the first two months of the current financial year amounted to 247 million marks as against 214 millions for the corresponding portion of the year before. The meeting will also be asked to approve the arrangements recently concluded with the Felten-Guilleaume-Lahmeyer businesses, about which notice has already been given.

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UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The new street lighting experiment at Hartford, Connecticut, is being watched by electric lighting engineers with keen interest. The Hartford Electric Light Company was the pioneer in street lighting with tungsten lamps, for it was as far back as the early summer of 1907, when the tungsten filament was a very problematic factor, that the company made the bold experiment of lighting West Hartford with some 200 60 c.p., 75 watt, 6·25 amp. tungsten lamps. Failure was freely prophesied, but the Hartford Company had made sufficient tests of tungsten to enable them to feel justified in going on with the installation, and it is an old story now that their confidence was fully justified by the event. A still more extensive experiment is now being undertaken, and the company has already installed in series nearly 2,000 tungsten lamps rated at 100 c.p. 125 watts each, the bulk of them being operated with 6·25 amps. In East Hartford all the alternating arc lamps have been replaced by these 125 watt tungstens with complete success. The lamps are fixed about 260 ft. apart, and eminently satisfactory illumination is afforded at an expenditure of 2·6 kw. per mile. During the earlier experiment, when the tungsten filament was of a far more fragile character than it is to-day, the average life of the 60 c.p. lamps worked out at 907 hours, the highest efficiency being 1,790 hours. It is too early yet to pronounce upon the life of the 100 c.p. lamps, but of 55 lamps which have burned out the average life was 806 hours, the maximum being 1,498 hours. As only 4% of the total installation had burned out, it is clear that the actual average of the aggregate will work out very satisfactorily. A test lamp (not in the street service) has, in fact, given 4,208 hours, and it is quite probable that the completed experiment of the street lamps will show an average life of considerably upwards of 2,000 hours.

The Allis-Chalmers Company.

The decision of the Allis-Chalmers Company considerably to extend the field of their operations in Europe, confers special interest upon an account of the rise and progress of this important incorporation in the United States which appears in the current issue of the "Electrical Review" of Chicago. Beginning its career as an engineering firm, in a very small way, in 1868, as the Edward P. Allis Company, the concern made its first big jump in 1877 with the famous Corliss engine, but it was not until 1902 that the manufacture of electrical apparatus was entered upon. A little later came their association with the Parsons turbine, and it was the Allis-Chalmers Company which carried the Parsons turbine to its present high state of development. Probably the principal improvement with which they were concerned was the shroud ring which holds the blades firmly in place and prevents any chance contact and disarrangement from their fixed position, and the low pressure balance piston. The company builds standard machines from 300 to 10,000 kw., both in high pressure and low pressure types, and has at the present moment in operation turbines of their own manufacture aggregating 250,000 kw. The firm has also paid special attention to the development of the gas engine, especially for use in connection with electric generators, for which purpose they are built up to 5,000 h.p. They have just completed such an outfit for the Indiana Steel Company totalling 150,000 h.p., thus making it the largest power plant of its kind in the world. The Allis-Chalmers Company now has six large plants, of which the most extensive, that at West Allis, near Milwaukee, is said to be second to none in the world. The site covers 110 acres, and the floor space is over 1,500,000 sq. ft. The power house develops 12,000 h.p. and high tension distribution to sub-stations in each shop supplies the power for driving the machines. For the most part, direct current from a multi-voltage system with individual drive is used. With the growth in its own business until it became one of the foremost manufacturing concerns in the country, the Edward P. Allis Company in 1900 was consolidated with several other concerns, and the Allis-Chalmers Company was formed. The companies in the merger were the Edward P. Allis Company; the Gates Iron Works, of Chicago, manufacturers of rock-crushing, cement and mining machinery; the Fraser & Chalmers Company, of Chicago, which was a manufacturer of mining machinery, pumps and air compressors; and the Dickson Manufacturing Company, of Scranton, which did a large business in Corliss engines and special machinery. This was followed in 1903 by the absorption of the Bullock Electrical Manufacturing Company.

High-tension Weatherproof Fuse.

With a view to meeting the new conditions imposed by the constantly increasing number of high-tension transmission lines, the Delta-Star Electric Company, of Chicago, is putting on the market a weatherproof fuse and disconnecting switch of completely new design, which has been thoroughly tested in actual operation prior to its introduction, and has proved itself efficient and trustworthy even under quite abnormal circumstances. In this device the line conductors are soldered directly to heavy detachable connectors arranged to be fastened to terminal plates which in their turn support a pair of jaws for the reception of the fuse chamber. On two projecting pins are mounted a pair of petticoat high-tension insulators having great mechanical strength and high insulating qualities. The design and dimensions of the insulators are such that the standard maximum creepage distance is secured, and the factor of safety is then doubled by employing designs for double the actual line voltage or test conditions. The fuse itself is of the enclosed type, so constructed as to resist the worst weather conditions, and with the blowing time practically constant under varying temperatures, the fuse has been specially designed to ensure rapid condensation of the expanding gases generated by the volatilization of the metal during the fuse period and to break up their continuity.

Transmission Line Calculations.

Mr. Alfred Still contributes to the current issue of the "Electrical World" an article on the inductance of electric transmission lines as affected by the sub-division of the circuits and the arrangement of the conductors, which raises many interesting points. Mr. Still sets out to indicate the manner in which the inductive drop of pressure may be reduced by substituting, for a single set of transmission lines, two or more sets of suitably arranged lines of a correspondingly reduced cross-sectional area, and he shows how in the case of a single-phase pair of wires sub-divided into two pairs of the same aggregate cross-section, it makes a very material difference how the two loops are supported relatively to each other. Their mutual inductive effect may be annulled, either by transpositions following the usual telephonic method, or by keeping the plains of the two loops mutually perpendicular. But still better results can be obtained by supporting the loops so that their magnetic fluxes shall oppose each other, in which case the induction drop in each case is found to be less than if the two loops are completely separated. Similarly satisfactory results, though perhaps in a less marked degree, are found when the same principle is applied to polyphase transmissions.

The Sturtevant Forced-draft Blower.

A new turbo undergrate forced-draft blower of special value to electric light and railway power plants that need increased draft during the peak of the load, is being placed on the market by the Sturtevant Company, of Hyde Park, Massachusetts. The specification describes it as consisting essentially in a single-stage impulse steam turbine direct-connected to a propeller type fan. The bucket wheel of the turbine is a solid steel forging carefully machined, the steam buckets being milled on the periphery of the bucket wheel. The construction of the steam case gives great accessibility for inserting, removing or cleaning the steam nozzles. An ample dust-proof phosphor-bronze bearing and thrust washers are provided with oil-cup lubrication. The construction of the bearing makes it possible to renew the bearing at a small cost. The built-up fan consists of six polished sheet-aluminium blades rigidly fastened with copper rivets into a bronze hub, which is finished all over to secure the proper balance necessary for high rotative speeds. The stationary members of the blower set are constructed of cast-iron parts of ample strength and rigidity.

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The blower is said to be practically silent in operation and to require a minimum amount of care and attention, as it can be controlled by hand-damper regulation or by regulating valves operated by the boiler steam pressure. As the exhaust steam from the turbine contains no oil, it may be used to best advantage for any work for which exhaust steam may be put, such as feed-water heaters, heating, etc. When discharging into the ash pit it produces excellent results with coals that would ordinarily cause serious trouble by clinkering. The wall thimble which forms anchorage for the set can be placed with equal ease in the front, side or back wall of the brickwork of the boiler setting.

A New Electric Car.

Manufacturers of electrically propelled motor cars in England will, doubtless, be interested in the specification of the 1911 model of the Waverley Electric which the manufacturers have sent to your correspondent. The new car is a four-seated brougham running a hundred miles on a single charge up to a speed limit of 25 m.p.h.; but the car can, if desired, be equipped with an Edison battery giving a 400 miles run. The mechanical equipment includes, of course, the Waverley high-efficiency shaft drive, now in its third year of highly successful operation. The principal feature of this drive is the use of herring-bone gears connecting parallel shafts. The controller is based on the principle of knife-blade contacts, and has an interlocking device that makes it impossible to change the speed direction with the power on, or to start on any speed but the lowest. The car runs in complete silence, with a smooth, easy motion almost wholly free from vibration, and its mechanism is so simple that it is practically impossible for it to get out of order. It is as easy to drive as a a sewing-machine, and a child can learn to operate it in 10 minutes.

New Type of Watt-Hour Meter.

Professor G. M. Willis has successfully completed his long series of experiments in the production of a new type of watt-hour meter, and the instrument is now being manufactured for the Willis Electric Meter Company by the Federal Electric Company, of Chicago. The meter embodies some important new principles, and is calculated to afford equal satisfaction to central station managers and to consumers. Professor Willis makes his instrument a "straight-line" meter, for the method of recording consumption in kw.h. is the direct-reading system used in cyclometers, the series of dials being replaced by a very simple method of counting in a straight line of figures which can be read at a glance. The number changes do not occur until a full unit of energy has been passed through the meter, and the reading is given in kw.h. without any multiplying constant. The meter is of the commutator-motor type, but with an exceptionally light rotating element, a ball-bearing, resting in a cup-shaped sapphire, being used to diminish wear and friction. Spur gears, plated with gold are substituted for the customary worm gears, and thus friction is still further reduced. The instruments are guaranteed not to vary in absolute accuracy more than 1% between full load and 5% of full load, but in the remote event of adjustment being necessary, it can be effected by means of plugs which eliminate any necessity for adjusting the damping magnets. The glass cover of the meter is hermetically sealed, and thus the instrument is airtight, dustproof, and dampproof. The terminal box is inside the meter case, so that theft of current is rendered impossible. Finally, the instrument is adapted for use in both alternating and direct current circuits, and can be changed from one to the other without adjustment or calibration.

Metal Filaments and Central Stations.

The development of the metal filament lamp and the central station problems arising out of it formed the subject of a large portion of the presidential address delivered by Mr. Thomas E. Murray at the 26th annual meeting in this State of the Association of Edison Illuminating Companies. Mr. Murray observed that the gradual changes in metering from a lamp-hour basis to the ampere-hour basis, and finally to the kilowatt-hour basis, have resulted in giving the consumer all the advantages accruing from improvements in lamp efficiency so that the use of the metal-filament lamp was expected to bring about a reduction in the consumption of energy. The immediate effect, he said, was restrained in great measure by the higher cost of the lamp; but the result has been in some cases a reduction in the kilowatt-hours sold of sufficient moment to offset the regular yearly increase of output, and in many cases, at least, reducing it so that the net figures show a lessened rate of increase in the output. On the other hand, in many cases the tendency has not always been to reduce the energy consumption to a minimum, but to divide it between economy, on the one hand, and on increased quantity and quality of light on the other. The ultimate effect will, in his view, be altogether beneficial to the central stations, and there is every prospect that metal filament lamps will, in future, be less fragile and liable to premature breakage and will have a longer life with a minimum of deterioration in candle-power. The prices also will be lowered, with better facilities for manufacture and a greater demand, and the ultimate result must be to place the central station in a stronger position than ever before.

DIARY.

WEDNESDAY, OCTOBER 12.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Fleet-street, at 8 p.m., Presidential Address by Capt. H. R. Sankey, R.E., on "The Ordnance Survey and the Design and Use of Machinery for Printing Maps."

FRIDAY, OCTOBER 14.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Section).—Conversazione, at 7.30, at the Whitworth Institute, Whitworth-park, Manchester.

FRIDAY, OCTOBER 21.

INSTITUTION OF MECHANICAL ENGINEERS.—At the Institution, Westminster, at 8 p.m., Mr. Cyril Hitchcock on "The Standardization of Locomotives in India, 1910."

"CRYSELCO."

Cryselco, Ltd., of Bedford, have just issued a most neat little pamphlet, brightly written, well printed and illustrated, describing the invention and manufacture of "Cryselco" carbon and metallic filament lamps. These are entirely of British manufacture, and are made in a variety of shapes—including the olive, tube and flame, so useful for decorative purposes—and in many sizes, ranging from 0 to 4m (from 2 in. to 2⅞ in. in diameter and 3 in. to 5⅞ in. in length overall, including cap). The pamphlet gives retail prices, and is suitable for distribution among private customers by dealers.

FOSTER ENGINEERING COMPANY.

As our readers know, the Foster Arc Lamp and Engineering Company, Ltd., have for some time past been gradually extending the range of their manufactures, and so have the allied Brockie-Pell Arc Lamp Company, Ltd. They have now been fully amalgamated and been re-named, with the sanction of the Board of Trade, the Foster Engineering Company, Ltd. This more clearly defines the scope of the firm's activities. With a view to further developments, both companies, or, rather, the two under the new title, have removed offices, stores and factories to capital premises in Morden-road, Wimbledon, where they have 3½ acres of land close to the railway. As regards electrical specialities, these will include the now well-known Foster "Flame" and "Enclosed" arc lamps, photo and process arc lamps, metallic filament lamps, auto-transformers, oil-cooled and high-voltage transformers, remote control and switches and mechanical governors, and the "Brockie-Pell" "Flame" arc and "Enclosed" arc lamps, metallic filament lamps, transformers and theatre dimming apparatus. With these various alterations completed, and the larger works at command, the Foster Engineering Company, Ltd., is insured increasing success, especially as they are in a better position than ever to fulfil promptly all orders sent to them.

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THE
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Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

Terms for displayed advertisements may be had on application.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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ELECTRICITY IN THE WORKSHOPS.

One of the notable features of the present revival of trade is the steady demand for the introduction of electricity into workshops. Many general engineering firms wisely took advantage of the slackness prevailing until recently to remodel their works, introducing time and labour saving systems in order to cope with the increased work anticipated. In most cases this meant the total discarding, or large displacing, of steam by electric power. Notable examples of this have been recorded in the Midlands, on the East Coast and up north in Yorkshire and Lancashire. While this relates to heavy engineering, it is also true of shops where smaller, often specialised work is undertaken, and to a somewhat lesser degree it also applies to the textile industry. It was found, notably by engineering firms, that this putting of their houses in order during slack time had paid them well, in securing larger output at smaller cost, the introduction of electricity greatly helping to this result. We have had authoritative reports to this effect from chairmen and managing directors at yearly and half-yearly meetings. All this has been noted outside, and now there are clear signs that smaller and miscellaneous works are following the lead of the bigger concerns. Apart from lighting, it is in this direction that the most general activity is shown in the electrical industry. This desire of so many diverse manufacturers to have their places electrified brings some anxiety to the electrical consulting and the manufacturing engineer, for it opens up many problems. First and foremost is the question of power: whether it should be generated on the premises or taken from outside sources depends upon many factors. As a rule factories are in or within easy reach of towns, but where they are isolated it is usually better to lay

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down a generating set. But where this is done, unless an outside service is available as a standby, it is necessary to have a duplicate set to guard against the inconvenience and loss of a beakdown. When the factory is within easy reach of an outside source of supply, arrangements for an emergency supply can be made, though, of course, at an enhanced price. Practice seems to make it clear that for small factories and workshops outside supply is both more economical and convenient. Central station policy is now happily bent on offering the best terms possible to manufacturers. As a rule, D.C. is most suitable for engineering workshops and wherever great flexibility is required, and certainly should always be adopted where individual motors are used. In certain shops, however, it is found possible to drive small machines on the group system, and in such cases constant speed running is the rule, so that the less flexible A.C. may be adopted. It is to be observed that group driving shows a tendency to degenerate into a fashion. It should be closely watched. No doubt there is economy in this plan of driving, which may be safely taken advantage of in many cases. But it must be remembered that it involves the loss of flexibility. Each case should be studied on its merits. It is certain that in some instances of recent electrification the extra expense of individual motors would have been justified on the score of greater flexibility and immunity from the worst results of small breakdowns. As regards the first, the recognition of the advantages of flexibility has brought about keen attention to the question of control, and great strides have been made in securing reliability. The criticism sometimes offered by users, however, is that the control is not always made as handy as it might be. Where we are dealing with machine tools, whether it be a small drilling machine, a lathe or a large planer, it is essential, if the utmost benefit is to be got out of the tool and the character of drive, that the control should be within easy reach of the operator. He should be able to modify and adjust while in his usual place and without stopping his work. Too often this is overlooked. The adjustment of control entails more or less displacement and inconvenience, with the result that the highest possible output, the greatest nicety in flexibility are not realised. This is a point that is felt by manufacturers and should receive careful attention from electricians. It is one of those large problems, requiring different solutions for practically every trade according to the nature of the machines and operations.

LEGAL.

Tramway Action.

DAMAGES FOR LOSS OF USE OF CAR.

In the Liverpool County Court the Liverpool Corporation have recovered damages for the loss of use of a tramcar. In July last a traction engine belonging to Wallace & Agnew, amusement caterers, of Bootle, ran into a tramcar at the junction of Hall-lane and Longmoor-lane. The Corporation claimed £17 1s. 9d. for damages to the car, and also £81 for the loss of the use of the car during the three weeks the repair work occupied. The claim was tried on September 19 in the Liverpool County Court, before Judge Thomas and a jury. The jury, after a lengthy hearing, each side contending that it was the duty of the other to stop their vehicle, found in favour of the Corporation. The claim for consequential damages had been left over for legal argument on the 22nd inst., but on that day Mr. Rigby Swift, for the Corporation, informed his Honour that the defendants had now admitted their liability, and had agreed to pay £12 on that account, which was accepted Mr. Lindon Riley, for the defendants, concurred, and Judge Thomas accordingly entered judgment for the plaintiffs for £29 1s. 9d. damages and costs.

ELECTRIC FANS ON SHIP'S BOARD.

A decision of considerable moment to passengers on liners was given by Judge Rentoul in the City of London Court last week.

Mr. Henry Justus Eck, of Bedford Park and the Union Electric Company, Ltd., succeeded in recovering £4 12s. 2d. from the Union-Castle Mail Steamship Company, Ltd., which amount was the sum charged for extra accommodation on their liner the "Avondale Castle."

Mr. Eck, his wife and daughter, went to Capetown in August last year by the Union-Castle line, travelling first class, and returned in December, paying £56 for accommodation.

After having been at sea a few days Mrs. and Miss Eck could no longer occupy their cabin, owing to there being a complete absence of ventilation.

The plaintiff's counsel stated that the company said in their booklet that a complete system of ventilation had been adopted, and that electricity was brought to bear on the cabins, saloons, etc., by the adoption of a large number of electric fans. Nevertheless, there was no fan in Mrs. Eck's cabin, and Mr. Eck had to pay £4 12s. 2d. to enable her to occupy a cabin where she could have the accommodation she needed. So he contended that the company had been guilty of a breach of contract and misrepresentation. It was claimed that the cabin without a fan was quite intolerable. The porthole of the cabin could not be kept open because of the trade winds.

In defence it was urged that the company did not guarantee that every cabin would have an electric fan in it.

"The case is of the greatest importance to all steamship companies, as actions may be brought against them broadcast," counsel declared.

Judge Rentoul, in giving judgment, said he thought anybody reading the booklet would think the cabins had electric fans in them, and Mrs. Eck's cabin had not. If there had been a fan in her cabin, no matter how badly ventilated it was, the company would not have been liable. If fans had been provided and they had gone wrong there would have been no case. He must, in the circumstances, find for Mr. Eck with costs.

He refused leave to appeal.

INDIAN ITEMS.

According to *Indian Engineering*, the Government of India have relaxed the code of the Public Works Department, which lays down that all works sanctioned in connection with electric installations in Government buildings should be carried out by or through the agency of the Public Works Department. It is recognised that the requirements of the Telegraph Department are special, engines and dynamos being installed in many offices from which electrical power is obtained both for working the instruments and electric lights and fans, so the Telegraph Department has been authorised to execute works and repair in connection with installations in telegraph buildings, including residences forming part of, or adjoining telegraph offices.

The Bengal and North-Western Railway, which already has 802 of its vehicles lighted by electricity on the Stone system, is now fitting up the remaining 465 vehicles on the same principle. The Rohilkund and Kumaon Railway also has 217 of its vehicles lighted on the Stone system, and it is probable that the remaining 81 will soon be converted from oil to electricity.

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ELECTROLYTIC ACTION.

Tramway Line Interference with Mains.

An interesting report has been presented by Mr. Harold Morton, electrical engineer to the Llandudno Council. It contains much that is important, and is reproduced below.

Troubles, says Mr. Morton, have occurred fairly frequently, though I am pleased to say not always with interference with the supply. For some time I have held the opinion that the trouble was due to electrolytic action caused by stray currents from the tramway supply. On May 23 a fault occurred on the distributing cable in Church-walks, when about 8 yards of cable was totally consumed; this being so, there was no trace of the fault left for examination. Another fault came on the following night at 11.35 p.m., this was on a pilot cable at the Marine corner, the cable was disconnected, but has not been removed from the ground, so no examination on that has been made. Two faults on the arc mains developed at the same time, and when removed, a piece of the cable was sent to Messrs. Glovers for an examination and report. Their report was that there was no trace of electrolytic action. The next fault was on a service cable that burnt right through; this caused no interruption to the supply, only to the house supplied; no examination was made. Another service cable was burnt out on July 29; this was a supply to Mr. Owens' house, Augusta-street. In this case all the armouring was eaten away, and owing to galvanic action the lead as well; this was clearly attributable to acid corrosion. This cable has been removed from the premises. There was no interruption to the supply other than the supply in question. On the night of August 1 a very serious fault developed soon after 9 o'clock; this proved to be on the feeder that supplies Craigydon and the front; this is also fed from the Marine corner. These were quickly separated, and the supply continued along the front to Queen's-road. The Grand Theatre Company were the principal sufferers, but their supply was given them shortly after 8 o'clock, a few minutes after starting the performance. The fault was in Maesdu-road and the cable had a hole burnt right into it. On the cable itself was a peculiar red deposit, which made a hard coating round the lead. The actual faulty piece was sent to Messrs. Glovers, and another sample sent to Messrs. Henleys for examination and report.

MESSRS. GLOVERS' REPORT.

"We find that the red coating on the lead covering of the sample is oxide of lead, which has undoubtedly been formed by electrolytic action. There is little doubt that the action has been the primary cause of the fault, because its effects have been more severe at that part than elsewhere on the sample. At the point the lead has probably been completely converted into oxide through its thickness; this would allow water to gradually penetrate and lead to the failure of the insulation. The character of the corrosion above referred to indicates that the current which has caused the electrolytic action has come from an outside source, such as electric tramway."

MESSRS. HENLEY'S REPORT.

"With reference to your letters of the 5th and 16th inst., respecting the corrosion which has appeared on the lead sheathing of the ·15 triple concentric cable (a small sample of which you sent us) we have examined this and beg to report as follows:—*Re* 3½ in. of triple c c lead covered from which the serving has been removed. The surface of the lead is rough and pitted in places. Although this is most marked on one side of the sample, it can be traced spirally following the path of the yarn serving. In and around the worst places a thin hard scale has formed which is of a brick-red colour. The red scale appears to be peroxide of lead. In the absence of any particulars as to the condition under which the cable has been laid and worked it is difficult to come to a definite conclusion as to the cause of the corrosion. However, judging from the sample alone, we are of the opinion that the corrosion is the result of electrolytic action, probably caused by leakage currents following along the lead and getting to earth through the damp serving. There may be something in the soil to assist the formation of peroxide."

ELECTRICAL ENGINEER.

If, as these two reports seem to infer, that the trouble is electrolytic, then the matter is very serious. I had my fears about it some time ago and wrote to the Manager of the Tramway Company in September and October, 1909, insisting upon his running the negative booster in order to reduce the rail-drop. Several complaints, both by letter and telephone, followed. On June 2 the following letter was written to the Manager:—"Will you please take steps to reduce your rail-drop; this is very excessive, and frequently exceeds 10 volts. I have had three cables burnt out lately and have more than reason to think that the trouble is due to stray currents." No action was taken, and on June 22 the following letter was sent:—

RAIL DROP.

"No notice has been taken of my letter of the 2nd instant, nor of verbal communications *re* the above. This matter is of grave importance to me, and unless immediate steps are taken to remedy I shall be compelled to write to Head Office enclosing a copy of the recorder Chart." On the instructions from Mr. Moorhouse, the booster was started on June 29, and has been kept running every day since and has improved matters.

STEPS TO REMEDY.

Now, with regard to the steps taken or about to be taken in order to confine any future fault to a small area and only the affected area, a scheme is in hand, and most of the material delivered to accomplish this, but unfortunately too late to commence before the season as it was not delivered till June 23. I purpose, however, commencing the work the beginning of October. Every step is taken to anticipate any fault and the feeders tested weekly.

On Sunday, August 7, in the early morning, I made a complete test of the distributor along the front from the Marine to Queen's-road, all consumers' switches being taken off, the feeder was tested from Rhydwen Jones' corner to the works, afterwards a box was opened at corner of Augusta-street and Trinity-street and the cable along Trinity-street disconnected at this point so as to further reduce that district, then the two legs of the distributor from Rhydwen Jones' corner along Mostyn-street to Trinity Church the one way, and along Vaughan-street and Augusta-street to the County Court Offices the other, were both tested and found to be good. This covers the whole district fed by what is called No. 2 feeder. Special attention was given to this district owing to some very bad kicks that have been noticed on the ammeters. These jumps have occurred nightly right down to the present date, except Sundays, which leads me to believe that it is legitimate load and is caused by either the theatre or Hippodrome. As a further precaution to protect this important district, I have fixed an underground fuse-box, so that in the event of any future trouble the district can be fed from either the Marine corner or from the Craigydon feeder.

In conclusion, I would remark that on the night of August 1 the residential district of Craigydon was without light; this was most unfortunate, seeing that the cause of the trouble was eliminated before 9 o'clock, but, owing to so many consumers having their switches on, and most inadequate means of making connection in the box, it was dangerous and totally unsafe to make the cables alive. It has shown clearly to me the absolute advisability of fixing a feeder pillar and distributing pillar in Queen's-road, the position and general arrangement being decided upon after completing the other portions of the town. I am also asked to consider the advisability of dividing the lighting of the town into two halves and running on different bus bars if required; I think that I can accomplish this now that I have a second balancer; and another improvement that I can suggest is doing away with fuses entirely at the works and substituting circuit breakers; these are safer in every way and far more reliable. This would to a certain extent necessitate a new feeder switchboard, but I do not consider the cost would be excessive. I purpose asking Messrs. Whipp and Bourne to go into this matter with me, and will report as to the probable cost later.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ABERDEEN.—The Town Council have declined to approve of the suggested scheme for giving a bonus to the electricity works employees.

BATH.—The substitution of the Osram lamps for the arc electric and gas lamps is going on rapidly and giving satisfaction to all concerned.

BISPHAM.—The Town Council having secured a Provisional Order and selected a site for a generating station, are now applying to the Local Government Board for powers to raise a loan for establishing the electricity undertaking. Strong local support is already assured as regards both lighting and power.

BRIDLINGTON.—The municipal electrical engineer reports that he had inspected the new turbo-generator at the works of Willans & Robinson, Ltd., Rugby, when he found that the machine went through its 10 hours' run without a hitch, and that all the guarantees were fulfilled with a wide margin in favour of the contractors.

CARDIFF.—Mr. Ellis, the manager of Cardiff Corporation electric lighting and tramways undertaking, reported to a meeting of the committee that he had had inquiries for electric lighting for houses just outside the city boundary at Whitchurch-road. This raised a very important question. There were 500 to 600 houses going up at Whitchurch-road, and he suggested the committee should approach the Llandaff and Dinas Powis District Council with a view to coming to an arrangement. As matters stood at present, they could supply power at the boundary in bulk, but they could not distribute. The committee instructed the clerk to write the Llandaff and Dinas Powis Council on the subject, and suggesting that they should receive a deputation to talk the matter over.

DOUGLAS.—At the promulgation of the new Acts from Tynwold Hill, the Governor of the Isle of Man stated that he was approaching the Postmaster-General about the laying of sea telephone cable from the English coast to Douglas.

DUNDALK.—The District Council has been authorised to borrow £20,000 to carry out the electric lighting scheme.

EDINBURGH.—As announced last week, the surplus of the City Electricity Works is to be devoted to further reduction of capital account. Mr. Newington's report for the year 1909–10 shows a total income of £127,102, of which £97,766 was for lighting and £17,949 for power (the latter at 1½d. per unit). The cost of production amounted to £58,501, while interest and sinking fund absorbed over £59,850.

GLASGOW.—Vigorous protests are being made against the use of the tramway surplus in reduction of rates. It is urged that the surplus should be used in improving the system or reducing the fares.

KINGSTON-ON-THAMES.—The municipal electricity works show a deficit of £500 on the past six months' working, and the estimated deficit for the year is now put at £1,600. It is urged that consumers should pay at a higher rate than the 5d. per unit now charged.

LONDON: POPLAR.—The Borough Electricity Works for the year ending March 31 last had a net income from the sale of current of £42,251, an increase of £4,441 compared with the previous year. Working expenses were £21,835, an increase of £2,368. The gross profit amounted to £20,415, as against £18,342, and the net balance of income over expenditure to £4,425, which, with £1,867, unappropriated balance from last year makes a total available surplus of £6,293. After applying £956 to certain purposes, there is an unappropriated balance to be carried forward of £5,336. The net result of the year's operations is 5% profit on the capital value of the undertaking.

MUTFORD AND LOTHINGLAND.—An application was about to be made by a private company for a Provisional Order for lighting the parish by electricity, but the scheme will be opposed by the Rural District Council.

OTTERY ST. MARY.—At a public meeting over which Lord Coleridge presided, Mr. Steeve, of Messrs. J. & W. Purves, of Exeter, explained that Messrs. Purves had carried out a great number of schemes for the provision of electric light in small towns like Ottery. A very important feature connected with Ottery was that there was an abundant water supply available for driving power. Consequently, the electricity could be generated as cheaply as it was possible to get it. In the proposed scheme the mains would be carried overhead in order to cut down cost. The mains would be available up to the end of every street in the town, and in some instances carried some distance out of the town, so that almost all people living within a reasonable distance of Ottery could be supplied. It was proposed to make a charge of about 6d. per unit. The capital required for a good scheme to be started was about £2,000. The expenditure for the first year's working would amount to something like £157 10s. The company were willing to assist financially up to about £500. An absolute estimate of the cost for getting the light into houses, shops, etc., could not be given, but it would roughly be, on an average, about 7s. 6d. to 10s. per lamp. The scheme is, we understand, likely to receive local support.

PAISLEY.—An arbitration, under the Paisley District Tramways Order Confirmation Act, 1901, to settle the price to be paid for the electrical energy for the next seven years by the Paisley District Tramways Company to the Paisley Corporation, will start on Friday, October 7, at the Westminster Palace Hotel. The arbitrator appointed is Mr. Robert Hammond, M.Inst.C.E.; the engineers engaged in the case are Messrs. Mordey & Dawbarn, on behalf of the Paisley Corporation, and Mr. Horace F. Parshall, on behalf of the Paisley District Tramways Company.

SURBITON.—St. Mathew's Church has been entirely re-fitted with Osram lamps, the lighting scheme giving great satisfaction.

WEST HAM.—At a meeting of the Corporation it was reported that the gross profits for the year ending last March on the trading account of the tramways was £6,000. After deducting £10,000 for the sinking fund and making other contributions, there remained £3,757, despite the opposition from the Socialist party, led by Mr. Will Thorne, M.P., who urged that the money should be put in its entirety to the reserve fund, it was decided to devote that amount to the relief of the rates.

YORK.—Draughtsmen are now at work preparing drawings, estimates and specifications for an extension of the stand-by plant at the City Electricity Works. The capacity of the plant is now 1,860 kw., at which it has stood since 1905. Although this is sufficient for immediate needs, it leaves the stand-by plant at a very low margin.

OVERSEAS.

BUENOS AIRES.—The Sociedad Co-operativa Luz Electrica de General Belgrano has been formed with a capital of 70,000 dollars. Mr. E. Volpatti, on behalf of French and English capitalists, has applied to the Buenos Aires Municipality for a concession for an electric light and power company. The concession to be for 50 years, after which time it would become the property of the Corporation. The other terms of the concession are more or less similar to those of the Compañia Alemana Transatlantica de Electricidad.

GREENVILLE, CAROLINA.—The Southern Power Company are putting up a 4,000 h.p. hydro-electric plant at the Great Falls, South Carolina, for the manufacture of nitrate from the atmosphere. It is the first installation of its kind in the United States.

TRACTION.

HOME.

AYR.—Mr. W. Grant in his report for the year ending May 15 shows that the Corporation Tramways had a total revenue of £15,007, of which £14,325 was for passenger traffic, £6 14s. 10d. for special cars, and £134 for the carriage of parcels. The expenditure was £8,571 (£2,237 for current). Of the surplus £1,962 was placed to depreciation account and £353 carried to the reserve fund.

GLASGOW.—The Corporation Tramways had a record week for the period ending October 1. The passengers carried numbered 4,787,424, an advance of over 370,000 over the same period of last year. The revenue was £19,874, an advance of over £1,900.

HASTINGS.—A horse was killed here last week as the result of treading on a "live" stud of a tramway.

KIRKINTILLOCH.—The movement for the extension of the tramway to this point is proceeding vigorously. At a recent meeting a committee was formed, and that committee has now decided to hold a public meeting for the appointment of another deputation. A similar movement exists in Torrance, where it was agreed to co-operate with the Stirlingshire village as far as possible. It was further agreed to make an endeavour to secure candidates to contest the wards on the tramway question at the forthcoming election.

LONDON: KENSINGTON.—The Royal Borough is opposing the County Council's project of running tramways from King's-road, Chelsea, to Fulham-road, and from Fulham-road to Brompton-road. The project would involve the widening of Fulham-road at a cost of £15,800.

SHIPLEY.—The work of re-laying the tramway, the working of which is leased by the Bradford Corporation, is now nearly completed.

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OVERSEAS.

LEGHORN.—The Società pei tramways di Livorno has purchased the steam tramway which runs from Pisa to Marina. Electric traction is to be substituted for steam, and the line to be extended from Marina to Leghorn.

OSAKA, JAPAN.—The British Vice-Consul states that since the commencement of the year numerous schemes have been brought forward for the construction of electric tramways to various places in the neighbourhood of Osaka, including one to Nara (a town of about 45,000 inhabitants, situated 25 miles east of Osaka), another to Kyoto on the opposite side of the Government railway to the line just completed, a line for an express tramway service between Osaka and Kobe, and many others. The only one, however, for which a charter has been obtained is a line to Sakai, a prosperous city six miles to the south of Osaka. This line will run parallel to the Nankai Railway to Wakayama, which has already been electrified as far as Hamadera (four miles beyond Sakai), and is shortly to be electrified for the rest of its whole length of 40 miles. The other tramway schemes, however, are hardly likely to mature for several years.

ROME.—The Government have granted a concession to the "Società Anonima delle Tramvie e Ferrovie Elettriche di Roma" for the construction and working of an electric tramway directly from Rome (via delle Cave) to Albano, a distance of 12 miles.

THE HAGUE.—The Government have granted a concession to the Geldersch-Westfaalsche Stoomtrammaatschappij for the construction and working of light railways from (1) the Lichtenvoorde-Groenlo station (on the Netherland-Westphalian Railway) to Zeddam; and (2) Lichtenvoorde to the Prussian frontier in the direction of Bocholt. The concessionaires will receive various provincial and communal subsidies, as well as a State subsidy of 150,000 gulden (£12,500) in respect of (1) and 90,000 gulden (£7,500) in respect of (2).

COMPANIES' MEETINGS AND REPORTS

DUNDEE AND BROUGHTY FERRY TRAMWAY.

Ex-Provost Brownlee, presiding at the annual meeting held in Dundee, moved that a dividend of 2 per cent. on the Ordinary stock and 6 per cent. on the Preference stock be declared. The chairman remarked that a good summer made all the difference in the results obtained, the line being really a fair-weather one. He thought they could look to the future with confidence. The motion was seconded by Mr. T. Balfour, London, and unanimously agreed to.

CLEVELAND AND DURHAM ELECTRIC POWER COMPANY.

The gross profits of the Cleveland and Durham Electric Power Company for the year ended June 30 amounted to £12,942, compared with £2,098 for the previous year. After providing for debenture and interest the net surplus was £2,906, which reduced the adverse balance brought forward of £3,657 to £751. The connections aggregate 36,283 h.p., an increase of 6,434. In addition 6,600 h.p. has been contracted for, and important negotiations are in hand. Mr. James Falconer, M.P., has been elected chairman of the company in succession to the late Mr. Charles Emmott.

BRITISH THOMSON-HOUSTON.

Mr. J. F. Nauheim, presiding at the meeting of the British Thomson-Houston Company, Ltd., said the accounts showed a distinct improvement on those of last year, but did not, in the opinion of the directors, warrant the payment of a dividend. The company had to meet severe competition both at home and abroad, and it was only by the strictest economy that they were able to cope with the difficulties of the position. The factory had been enlarged, and he hoped the shareholders would reap the benefit of this next year. The company now owed the General Electric Company of New York £174,000, against £161,000, which was the corresponding figure in the previous year's balance-sheet, while sundry creditors had decreased from £122,000 to £120,000. Apparatus, meters, supplies, etc., stood in the books at £298,000, having increased from £255,000 the year previous, as a result of increased trade. Sundry debtors had decreased from £244,000 to £234,000.

WILLANS & ROBINSON.

The directors report that for the half-year ending June 30, after writing off the sum of £1,422 1s. 4d. as depreciation; paying £4,216 18s. 1d. interest on debenture stock and £593 6s. 5d., the cost of the upkeep of the Queen's Ferry Works, the result of the half-year's trading shows a loss of £8,001 14s. 3d. Added to the balance £7,267 2s. 6d. brought forward from the previous half-year, this brings up the total of the debit standing against the profit and loss account to £15,268 16s. 9d. Debentures representing £6,104 have been redeemed during the half-year out of the fund set aside for that purpose, and having been purchased at a discount the profit on the transaction has been transferred to the reserve fund. The unsatisfactory result for the half-year under consideration is due to the low prices prevailing and the scarcity of orders obtainable during the whole of the year 1909. There has, however, been a steady improvement in the volume of orders booked during the present year, but although the amount of work in hand is now fairly satisfactory and orders are continuing to come in at an increasing rate, yet the prices obtainable are on even a lower scale than for the year 1909, and until there is a material improvement in this respect it will not be possible to show a profit. Every effort is being made to reduce costs so as to leave a margin on the selling prices. Important improvements have recently been introduced in the steam turbines made by the firm. These improved turbines are showing extremely good results in working and their merits will, undoubtedly, lead to increased sales. The agreement with the Diesel Engine Company has been terminated and the company is free from October 1 to sell Diesel Engines in any quarter required—a business that will be vigorously pushed. The directors are doing everything that is in their power to carry the company through the present very difficult times, and only regret that they have to call on the shareholders for a further instalment of patience. With regard to the item set down in the balance sheet as the value of the Queen's Ferry Works, as the directors have intimated more than once to the shareholders, there will probably be a considerable book loss when the property is sold. This forecast holds good to a minor extent in regard to the premises at Thames Ditton. The purchase of the Queen's Ferry Works is at present under option to a syndicate, for which option a substantial sum has been paid. Should the option to purchase be exercised, the sale should be completed within the next few months. The amount of the loss will then be ascertained and the item will disappear from the balance sheet. As provision against this contemplated loss there is on the other side of the balance sheet a reserve fund amounting to £44,643 15s. 9d.

COMPANIES REGISTERED.

LONDON & GENERAL ELECTRIC THEATRES, LTD.—£10,500, in 10,000 Ordinary shares of £1 and 10,000 Deferred shares of 1s. 38–9, Piccadilly, W.

ALLMANNA SVENSKA ELECTRIC COMPANY, LTD.—£5,000, in £1 shares. Business: That indicated by the title. Private company.

LLANGEFNI ELECTRIC LIGHT AND POWER.—Capital, £3,000, in £1 shares (2,750 Five per Cent. Cumulative Preference and 250 Ordinary). Objects: To carry on the business indicated by the title. Minimum cash subscription, 1,250 shares. The first directors (to number not less than two nor more than seven) are: Major L. Williams, J. Jones, W. Owen, E. J. Owen and L. Milne. Qualification, £100. Remuneration, £30 per annum divided. Registered office, 66, Victoria-street, S.W.

ALLIANCE ELECTRICAL STORES.—Capital, £25,000, in 47,500 Preferred Ordinary shares of 10s. each and 1,250 Deferred Ordinary shares of £1 each. Objects: To take over the business of electricians, electrical engineers, etc., carried on by the Alliance Electrical Company, Ltd. (in liquidation). Minimum cash subscription, seven shares. The first directors (to number not less than three nor more than seven) are: T. Fons (chairman), J. E. Coles and W. R. N. Grimley. Qualification (except first directors), 250 shares. Remuneration, £150 each per annum.

TELEPHOS DOMESTIC AND STREET LIGHTING.—Capital, £50,000, in 5s. shares. Objects: To carry on the business of manufacturers of and dealers in "telephos" gas switches, automatic lighting and extinguishing apparatus for street lamps, etc. Minimum cash subscription, seven shares. The first directors (to number not less than two nor more

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than seven) are: Sir James Heath, Bart., Leamington; Capt. A. St. J. Cooke, D.S.O., 824-6, Salisbury-house, E.C.; A. E. Broadberry, A.M.I.C.E., Elmlea, Willoughby-lane, Tottenham, N.; H. L. Down, Asmun-square, Hendon, N.W.; E. Huntley, J.P., 156, John-street, Sunderland; and J. T. Mail, 17, Sandhill, Newcastle-on-Tyne. Qualification (except first directors), £100. Remuneration, £300 per annum and a percentage of the profits. Secretary, C. A. Underwood. Registered office, Capel-house, New Broad-street, E.C.

PERSONAL.

Councillor Thornley has been appointed chairman of the Darwen Electricity Committee, in place of Alderman Lightbown, deceased. Councillor George Pickup has been appointed vice-chairman.

Mr. E. B. Greenhaus, second shift engineer at the Dover Corporation Electricity Works, has had his salary increased to £90 per annum.

Mr. W. A. Turnbull, Chief Assistant Electrical Engineer to the City of York, has been appointed Resident Electrical Engineer at the Stoke-on-Trent Electricity Works, under Mr. C. H. Yeaman, the Chief Electrical Engineer of the County Borough of Stoke-on-Trent.

EDUCATIONAL.

BRADFORD TECHNICAL COLLEGE.

At the rear of the Bradford Technical College extension—which adjoins the main buildings, and will comprise laboratories, museum and library—there will be a fairly large power house, with electrical plant for supplying both light and power for the whole establishment, and being utilised as part of the educational equipment. For this purpose the plant is being made as comprehensive and representative as possible. There will be a slow-speed set, comprising a horizontal cross compound engine, driving by means of rope, an 85 kw. open type shunt-wound D.C. generator; a high speed set comprising an inverted vertical enclosed two-crank compound engine, direct coupled to a 75 kw. D.C. shunt-wound generator; a 75 kw. steam turbo-alternator set; and a suction gas plant, driving a 75 kw. generator.

MANCHESTER I.E.E. CONVERSAZIONE.

The Manchester Local Section of the Institution of Electrical Engineers will, as already announced in our columns, open the Session with a conversazione. The date has now been fixed for October 14, and the place of re-union the Whitworth Institute, Whitworth Park, where the chairman and Mrs. Peck will receive guests at 7.30. An excellent musical programme has been arranged, and every effort is being put forth to make the event a success. A cordial welcome is assured to all engineering friends, and it may be as well to remind our readers that tickets may be obtained from the Hon. Secretary, Mr. H. W. Wilson, 19, Brazenose-street, or from the Assistant Secretary, Mr. A. L. Green, 8, Westminster-avenue, Manley Park.

MUNICIPAL AND COUNTY CLUB.

Mr. Justice Avory will be the guest of the evening at a house dinner and smoking concert to be given at the Municipal and County Club on October 20 next. The Lord Chief Justice, who is president of the Club, will be in the chair.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

GREAT WESTERN RAILWAY.

The DIRECTORS OF THIS COMPANY are prepared to receive tenders for the supply of the undermentioned Stores:—

No. 1 GROUP.

For one year's supply from December 1, 1910, to November 30, 1911.

1.—Bricks.
2.—Lime, Plaster of Paris and Cement.
3.—Stone, Artificial Stone Paving, Slates and Drain Pipes.
4.—Fire Bricks and Fire Clay.
5.—Glass—Plate and Sheet.
6.—Lamp Glasses, Globes, Tubes, &c.
7 & 8.—Drysalteries, Emery, Soap, &c.
9.—Acids, Alkalies, &c.
10.—Oils and Turpentines.
11.—Colours, Paint, White & Red Lead, &c.
12.—Mineral Oil and Spirit.
13.—Brooms and Brushes.
14.—Incandescent Gas Fittings.
15.—Rope and Cordage.
16.—Leather.
17.—India Rubber Goods.
19.—Telegraph Apparatus (Insulators, &c.).
20.—Electrical Wires and Cables.
21.—Telegraph Ironwork and Tools.
22.—Telegraph Drysalteries.
23.—Electric Light Carbons.
25.—Zinc, Antimony, Brass, Copper Rivets, &c.
26.—Tin Plates.
27.—Tin Ware and Lamp Work.
28.—Wire—Iron and Steel.
29.—Rivets, Bolts and Nuts.
30.—Fish Plates, Bolts & Nuts for Permanent Way.
31.—Nails, Screws, &c.
32.—Eaves Gutter, Stack Pipes & Fittings.
33.—Galvanized Goods.
34.—Sundries.
35.—Canvas, Felt, Sacking, Cloth, &c.

Samples and Patterns may be seen at the General Stores, Swindon, from Monday, October 10, to Saturday, October 15, at the following hours, on application at the Office of the Stores Superintendent, Swindon:—

Monday to Friday .. 10 a.m. to 5 p.m.
Saturday .. .. .. 10 a.m. to 12 noon.

Specifications, with Forms of Tender (upon which alone Tenders can be received), may be obtained at the Office of the Stores Superintendent at Swindon.

Tenders addressed to the undersigned, and marked outside "Tenders for Stores," will be received on or before Tuesday, October 18.

The Directors do not bind themselves to accept the lowest or any Tender.

A. E. BOLTER, Secretary.

Paddington Station, London,
October 1, 1910.

COUNTY BOROUGH OF HALIFAX.

The Tramways and Electricity Committee of the Halifax Corporation invite TENDERS for the supply of the following PLANT required in their Electricity Department:—

Contract No. 1. One 1,500 kw. Turbo-Alternator complete with Condenser.

Contract No. 2. Two 750 kw. Rotary Converters complete with Transformer.

Contract No. 3. Switchboard and Platform for the above Plant.

Specifications may be seen and forms of Tender obtained on application to Mr. W. M. Rogerson, M.I.E.E., Borough Electrical Engineer, Electricity Works, Foundry-street, Halifax, upon payment of the sum of £10 for each Contract, which will be forfeited should the Contractor not send in a *bona-fide* Tender, or afterwards withdraw his Tender. Tenders, endorsed "Electricity Works, Contract No. —," must be sent to the undersigned not later than 12 o'clock noon on MONDAY, October 17, 1910. The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation. The Committee do not bind themselves to accept the lowest or any Tender.

HERBERT ASHLING,
Town Clerk.

APPOINTMENTS.

NORTHAMPTON POLYTECHNIC INSTITUTE.
ST. JOHN-STREET, E.C.

ELECTRICAL ENGINEERING AND APPLIED PHYSICS DEPARTMENT.

The Governing Body invite applications for the post of Laboratory Demonstrator in the above Department; applicants should be qualified to take charge of Heat, Photometric and Electrical Engineering Laboratory; commencing salary £100 per annum; also Junior Demonstrator, commencing salary £80 per annum.

For particulars and forms of application, which should be returned not later than October 10, 1910, apply to

R. MULLINEUX WALMSLEY, D.Sc.,
Principal.

CONTRACTS OPEN.

HOME.

BARKING.—Barking Town Urban District Council.—Tramcars complete with trucks and electrical equipment. Particulars 10s. 6d., Tramways Manager, East-street Works. October 12.

BOURNEMOUTH.—H.M. Office of Works invite tenders for the erection of the Bournemouth Parcel Sorting Office and Telephone Exchange. Particulars from H.M. Office of Works, Storey's-gate, Westminster. October 14.

CHESTERFIELD.—Electrical Energy Committee invite tenders for the supply and delivery of 12 months supply of fine slack, up to 5,000 tons. Particulars from the Borough Electrical Enigneer. October 10.

EDINBURGH.—Corporation.—No. 59.—Three steam turbo-generators, each of 1,200 kw. capacity, with the necessary condensing plant.—No. 60.—Interior parts of the cooling towers to deal with 420,000 gallons of water per hour. Specification, £2 2s., Engineer, Dewar-place. October 10.

EPSOM.—The Urban District Council invite tenders for the supply of coal to the electricity works until the end of September, 1911. Particulars from the Electrical Engineer. October 15.

HACKNEY.—Borough Council.—90,000 pairs white, open type, arc lamp carbons. Specification, £1, Town Clerk. October 13.

HALIFAX.—The Tramways and Electricity Committee invite tenders for the following plant: (1) one 1,500 kw. turbo-alternator complete with condenser; (2) two 750 kw. rotary convertors complete with transformers; (3) switchboard and platform for the above plant. Particulars, (£10) from the Borough Electrical Engineer. October 17.

LONDON.—London County Council invite tenders for the road-work and platelaying required for the re-construction on the conduit system of the Council's tramways in Highgate-road, and for the paving works of certain street widenings in connection therewith. The route is equivalent to about 1½ miles of single track. The contractor will be required to use the track rails with their fastenings, the slot rails, the conductor rails, and the special work for the turnouts, etc., which will be provided by the Council under other contracts, but all the remaining metal work and other materials will be included in the contract. Particulars from the Chief Engineer, County-hall, Spring-gardens, S.W., upon payment to the cashier of the Council of £5. October 11.

LONDON.—London County Council invite tenders for an electrical installation at the Sherington-road Central Elementary School, Greenwich, S.E. Particulars (20s.) from the Chief Engineer, Spring-gardens, S.W. October 12.

LONDON.—The Great Western Railway Company invite tenders for the supply of (17) India rubber goods, (19) Telegraph apparatus (insulators, etc.), (20) Electrical wires and cables, (21) Telegraph ironwork and tools, (22) Telegraph drysalteries, (23) Electric light carbons, (25) zinc, antimony, brass, copper, rivets, etc., (28) Wire, iron and steel. For particulars, see official advertisement. October 18.

OSRAM LAMPS

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OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage électrique à Béni-Souef—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministère de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

CAIRO.—The Chief of the Administrative Service, Ministry of Public Works, Cairo, invites tenders for electrical installations and refrigerating plant for the lunatic asylum in course of construction at Khanka. The specification may be obtained on application to the Chief of the Administrative Service, Ministry of Public Works, Cairo. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.), and enclosed in a sealed envelope marked "Offre pour fourniture des installations électriques et à glace pour l'hôpital des aliénés, à Khanka," will be received up to noon on October 20, at the office of the Chief of the Administrative Service, Ministry of Public Works, Cairo. It is to be noted that (legal) domicile at Cairo is necessary in the case of the above two contracts. For conditions under which temporary (legal) domicile may be obtained by British firms at the British Consulate at Cairo.

JERUSALEM.—Administrative Council of the Town.—Electric lighting and telephones. Deposit 8%. October 13.

LORENZO MARQUES.—Port and Railways Administration.—Seven electric cranes (one, five and ten tons). Specification, Direction des Chemins de Fer d'Outre-mer, Lisbon. October 12.

PARIS.—The "Moniteur Officiel du Commerce" (Paris) contains a notice inviting tenders for the supply and laying of a submarine cable between Libreville and Loango (Pointe Noire). To qualify tenders, a provisional deposit of 50,000 francs (£2,000) will be required, to be increased by the successful tenderer to 100,000 francs (£4,000). Tenders will be received up to October 14 at the "Bureau de l'Ingenieur Chef des Etudes, Ministere des Colonies, rue Oudinot No. 27," Paris.

SHANGHAI.—Tenders are invited by the Shanghai Electricity Department for the supply of the following: (1) Electric heating and cooking appliances; (2) 10,700 carbon filament lamps; (3) 15,000 metallic filament lamps. Sealed tenders, marked "Tender for Heating and Cooking Appliances," or as the case may be, should be addressed to the Acting Secretary, Council Rooms, Shanghai. Date: (1) October 10; (2) and (3), October 20.

NOTES.

"O-S." Wiring.

Messrs. Siemens Brothers & Company, Ltd., have favoured us with a copy of their new catalogue, No. 517, relating to "Stannos" wires (September, 1910, issue). This supersedes all previous catalogues on the subject. We note that the prices have been reduced considerably. It appears that since the "O-S." wiring system was introduced at the commencement of last year, the demand for "Stannos" has exceeded all anticipations, and continues to increase. This continuance of popularity is natural, for various improvements and extensions in the details of the system have been evolved, the outcome of the experience of Messrs. Siemens Brothers and of their customers. Information on all these points is set out clearly in the new catalogue, but special attention is drawn to the following: "Stannos" wires are now made in seven sizes (from 1-18th to 7-16ths), and with ordinary and heavy sheathing. The ordinary sheathing is only used for sizes up to 7-20ths, whereas the heavy sheathing is employed on all sizes. The larger sizes now enable "Stannos" to be used for wiring to motors and for other main circuits, thus dispensing with large size tubing and obtaining a neater and less expensive job. The heavy sheathing is specially suitable for wiring of ships, railway coaches, or other places where the wires may be subjected to special mechanical and atmospheric influences. Special prominence is given to the adaptability of "Stannos" to concentric wiring (where this is permitted), and for this purpose a variety of continuity fixtures and other accessories are listed, including double-wound transformers and low-voltage "one-watt" lamps. Great attention has recently been given to the cheapening of house services, and for this purpose Messrs. Siemens have introduced a "Stannos" house service box at a very moderate price, by means of which a row of contiguous houses can be fed. The box takes a low tension concentric service cable up to ·05 sq. in., and outgoing "Stannos" mains up to 7/16S.W.G., which run along the fronts of the houses and branch off to smaller "Stannos" wires by means of special watertight "Stannos" tee-joint boxes. Several new sizes of the latter are listed. The catalogue also contains a special line of "Stannos" fuse boards with Siemens "Zed" fuses. The whole is well illustrated, and includes lucid descriptions of the system and instructions for erection. The catalogue is, of course, intended chiefly for the trade, but Messrs. Siemens Brothers & Company, in response to many enquiries, and recognising that the contractors cannot educate the public without adequate publicity material, have issued a showcard, lithographed in nine colours and measuring 20 in. high by 15 in. wide, which we illustrate herewith, although it must be admitted that it is impossible

to do the colour scheme justice in mere black and white. The design and subject have been chosen with the twofold object of attracting the attention of customers of both sexes, and of laying stress on a point that must appeal to both more or less equally, namely, that the "O-S." system means "House Wiring without Discomfort"—a motto that appears to have "caught on." In addition, Messrs. Siemens Brothers have published a picture postcard of this design in three colours, with a communication to the public on the front half, which will be found equally suitable for despatch to prospective consumers by contractors and by station engineers. Showcards and postcards will be sent free, on application, to all who are willing to exhibit, and despatch them respectively, and if postcards are ordered in quantities of 100 and upwards, customers' names and addresses will be over-printed free of charge. All those who are interested in the subject, and have not received the new catalogue, should apply to Messrs. Siemens Brothers & Company.

Lighting a Canal.

The series of locks on the Caledonian Canal at Banavie, known as Neptune's Staircase, were on Tuesday night for the first time lighted by electric light. The installation was laid by Mr. D. Bryce, electrician, Fort William, and the power is obtained from the Fort William Electric Company, Ltd. In this connection it is interesting to note that the burgh of Fort William was the first in Scotland to take advantage of electricity for lighting. A powerful light dominates each of the nine locks which make the ascent from the Corpach reach to the level at Banavie, and a light of double power commands the bridge carrying the public road over the canal near the Post Office.

"Osram" Assisting the Trade.

In the autumn the contractor's fancies seriously turn to thoughts of "light." At the moment it is of more than ordinary interest to look around and see what new moves

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are being made by station engineer, contractor and manufacturer, to further the interests of electricity as the chief illuminant. In this peep round one's thoughts of necessity turn immediately to the doings of friend Osram. Friend we say, and friend indeed it has proved, for it came at an opportune moment. Not only did it bring a new industry into this country, and with it the employment of hundreds of British workpeople, but it has also provided for the electric supply undertakings, a sturdy weapon with which to fight the gas interests, and for the contractor a selling line that has gained lasting popularity. Certainly the G.E.C., having got a good thing, have known how to make the fact appreciated far and wide.

The advertising policy of the "Osram" has always been quite distinctive, probably due to the soundness of their establishment upon the market. "Osram lamps make electricity cheaper than gas," that is the keynote of their advertising—and could they have selected a better battle cry. War against gas—that's their policy, and in it the trade will undoubtedly find the open door to greater and more rapid expansion. Once you can persuade the public to realise this fact—and fact it is—then we commence to walk where previously we have crawled. For months past Osrams have been at war with gas for street illumination—the net result to-day is that over 140 towns in this country alone use Osrams for street lighting, and in most cases have ousted gas to take its place.

Now, the advertising policy is to teach the public. To do this the advertisement department have produced an exceptionally striking poster, measuring 120 × 80 in., and printed in 8 colours, which is now being (or about to be) displayed in selected towns throughout the Kingdom. Copies are also being offered to all contractors who would care to display same on their premises, with additional slip to paste underneath bearing the words "sold here." It is already to be found on the London Tube Railways in well selected and prominent positions, and from our own observations has created exceptional interest. An extensive Press advertising scheme has, we understand, been organised to further assist in teaching the public that "Osrams make electricity cheaper than gas." Whilst a wonderful assortment of advertisement folders, price lists, picture post-cards, novelty cards, picture albums, leaflets, invoice forms, adhesive labels, show cards, window bills, are offered to the trade, printed with contractor's name and address thereon, free of charge. We cannot help but feel that any contractor who does not avail himself of this generous offer and use it to the best possible advantage, will be very short-sighted, as the present active efforts of the General Electric Company's Advertisement Department are bound to result in considerably increased business, which will naturally go to the contractor in each district who associates his name most widely with the sale of the lamp.

We understand that the General Electric Company have another big Osram advertising surprise up their sleeves for development a little later on, but of this more anon. The present general scheme appears to be just about as complete as it is possible to be, and every possible means of reaching the public appears to have been included. Such an effort must help matters for the trade.

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PATENTS.

Boxes for Containing Electric Lamps.

23873.—1909. A. H. STEVENSON, Manchester. The box, which is made of cardboard, has a central hole for receiving the point of the lamp. A clear air space is left all round the lamp, which is thus prevented from concussion against the sides of the box.

Electric Switch.

28423.—1909. J. B. WYNNE, Ovoca, Ireland. This is an improvement in tumbler switches of the quick make and break type, and the object is to enable sliding contacts to be used. One end of the spring telescopic link is pivoted to a carrier fitted with spring contact blades adapted to be reciprocated by the carrier as the tumbler lever and link are moved beyond the position of alignment in one direction or the other.

Electric Arc Lamps.

29068.—1909. H. HIRST, AND A. E. ANGOLD, Salford. This is an improvement in lamps of the type in which the feeding of the electrodes is automatically governed by using two converging electrodes for each or either pole and arranging them to move forward simultaneously at such unequal relative speeds that the arc remains steadily burning on the faster moving carbon, and the slower one is consumed by the action of the oxygen and heat transmitted to it from the arc, the arc itself only forming on the slower moving carbon when the oxygen has failed to consume it fast enough. The object is to provide an improved means of governing the relative speeds at which the carbons advance. For this purpose the holder of the faster carbon has a projection which rubs against a rod standing at a small angle to the path of the holder. The rod is pivoted to two links in the manner of one limb of a parallel ruler. The lamp frame constitutes the other limb of the ruler so that a side pressure on the rod will displace it but will not alter the angle at which it stands relative to the path of the carbon holder. One of the links has a projection which operates the slower carbon. The advance of the faster carbon causes a pin on its holder to push the rod slightly sideways. This actuates the levers and the slower carbon is advanced in proportion to the slope of the rod and the length of the link and its projection which operates the slower carbon.

Sparking Devices for Internal Combustion Motors.

1130.—1910. L. DUTHIEL AND R. CHALMERS ET CIE, Paris. This revolving sparking appliance consists of a carrier to which a series of sparking plugs are attached. A conical piece forming a pivot for the plug carrier is attached to the cylinder and a stationary wheel current to the rubbing contacts is attached to the sparking plug. By rotating the plug carrier or the conical piece one or the other of the sparking plugs is brought into use.

Electrical Vaporiser.

2286.—1910. P. BLUM, Paris. The vaporiser comprises a transparent chamber, the upper part of which is perforated. The substance to be vaporised is placed in the bottom of the chamber. A glow lamp which may be raised or lowered is suspended within the top of the vessel. The device may be used for illuminating purposes as well as for vaporising.

Insulating Wall Boxes for Electrical Apparatus.

5835.—1910. E. NEUDORFFER, Stuttgart. The wall box is composed of ceramic material and enclosed in a yoke shaped support. Slots and recesses are formed on the under side of the yoke for the reception of the heads of the screws used to attach the box to the wall.

Alternating Current Induction Motor.

5985.—1910. W. I. SMITH, J. D. GREEN, AND A. W. GLOVER, Leeds. This is an improvement in motors in which the stator of the motor is permanently fixed to the base plate or formed in one piece with it whilst the armature is built on a sleeve rotatable on the shaft of the motor and in which a cone driving connection is provided between the rotor and the shaft of the motor. The rotor cone plate is fixed to one of the outer sides of the rotor. On the same side of the rotor a corresponding shaped clutch plate is mounted on the shaft, capable of sliding axially thereon, but constrained to rotate the shaft when it is itself rotated. A spring which embraces the shaft is fitted between the clutch plate and a collar fixed close to the bearing of the shaft. The spring tends to press the clutch plate against the friction plate on the rotor sleeve. The strength of the spring is such that the friction clutch device does not act with sufficient rapidity to reduce the speed of the motor to an objectionable amount below normal.

Electric Switches.

6160.—1910. THE CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee, U.S.A. The invention provides means for moving a switch lever in opposite directions alternately on the energisation of a solenoid. A bifurcated member is pivoted to the core of the solenoid. This member has a pointed projection and is so arranged that when left free after being rocked in either direction it will always return to its initial position.

Electric Switches.

6363.—1910. CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee. The switch comprises a movable member carrying contacts which, together with contact fingers form a reversing switch for a main circuit. An auxiliary contact closes a parallel circuit when the movable member is moved in either direction to close the main circuit contacts of the reversing switch. An insulating member carried by the movable member supports the auxiliary contact.

Electrical Energy Meters.

6667.—1910. BRITISH THOMSON-HOUSTON COMPANY, LTD., London, E.C. A potential core is connected to the U shaped current core of an electrical energy meter such as described in specifications 27343.—1908, and 6565.—1909. The connection of the potential core to the current core is at a point below the coils carried by the current core. This arrangement enables the use of the meter casing as a path for part of the potential flux to be dispensed with.

Electric Arc Lamps.

7821.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. The invention consists in applying a permanently excited electric motor to control the distance between the lamp electrodes. The motor is switched directly to the electric supply mains at starting without any starting resistance. The armature of the motor is short circuited as soon as the necessary regulation has been effected. By this means the starting and stopping of the motor is rendered instantaneous while the adjustment of the electrodes is quick and accurate. The mechanism for actuating the motor takes the form of a main relay switch which may be wound with a shunt or main current winding or with a differential winding. The main relay switch actuates one of two auxiliary relay switches which open and close the main motor switch.

Duplex Systems of Electric Telegraphy.

8141.—1910. J. KAJIURA, Akasaka, Japan. This invention which may be termed the semi-bridge duplex, refers to a duplex system to be used upon cable and other telegraphic circuits containing or not containing overhead wires. The object is to reduce the number or capacity of artificial cables required and to enable exact duplex balancing to be more easily and rapidly attained and thereby increase the working capacity of cable circuits. The rise and fall of potential in relation to time is intimated at an intermediate position of line cable by a sending battery at the home station. The artificial cables corresponding to the line cable beyond the intermediate position are dispensed with.

Coin Freed Electric Alarm Bell.

8327.—1910. J. GRATH AND H. DREXLER, Vienna. These alarm bells which are intended for use in connection with doors which have to be opened at night, or for night calls are set in motion through the introduction of a coin. The use of the coin prevents unauthorised calls or bogus alarms being made. When the door is opened the contact set up by the insertion of the coin is broken and the bell ceases ringing.

Time Switch for Electric Lighting.

9590.—1910. J. BERG, City-road, E.C. This time switch for electric lighting is unlocked a short period before the pre-arranged time of action. A crank lever actuated by the timing mechanism locks and unlocks a catch member provided with arms one of which engages a cam controlling the switch mechanism and a stop, while the other arm engages an operating pawl arranged in conjunction with the switch.

Device for Operating Magneto-Electric Machines.

10820.—1910. A. ZAHRINGER, Stuttgart. This is an improved device for operating magnetic-electric machines of the kind in which the armature is held between the poles of the magnet system by springs which compel it to return to normal position when it has been turned through an angle out of this position, and then has been released. According to the invention the cam is placed to one side of the axis of the armature and is fixed to a lever. The springs bear not only against the cam but against a fixed projection which retains one spring in its normal position whilst the other is deflected, the projection being symmetrical with respect to the line joining the axis of the pivot of the spring system and the axis of the armature.

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Separating Substances by the Wet Magnet Process.

17459.—1909. F. KRUPP, A.G., Grusonwerk, Madgeburg-Buckau. Between the surface of a flowing liquid containing the material to be separated and a device for carrying away the separated magnetic material liquid, walls are formed in which the magnetic particles are lifted without previously leaving the surface of the flowing liquid.

Electrical Means for Securing the Safe Starting of Motor Cars.

19747.—1909. W. J. BROOKS, Letchworth. A switch arm in passing from the off position to the main contact block passes over and touches an intermediate contact block by means of which a current is made to flow through an electro-magnet in the switch and thence to a contact piece situated in respect to any part of the motor car so that when such part is in the "safe" position it makes contact with the adjacent contact piece and the circuit is completed through the electro-magnet during the passage of the switch arm across the intermediate contact block.

Apparatus for Electroplating.

20057.—1909. S. O. COWPER-COLES, Westminster, S.W. The apparatus comprises a drum for containing electrolyte mounted on rollers at one end and connected at the other end to a sleeve rotatably mounted in a trunnion supported on a pedestal. A shaft extends through the sleeve and into the drum. An anode is suspended from the shaft. The drum and shaft are provided with means for rotation.

Production of Long Continuous Electric Arcs.

20129.—1909. BADISCHE ANILIN UND SODA FABRIK, Ludwigshafen. This is a modification of an invention for producing long continuous arcs described in specification 14955.—1905. The modification consists in causing air or other gas to pass into the arc tube at more than one place near the middle of the length of the tube and to pass out near the electrodes at each end of the tube.

Wireless Telegraph Transmitting and Receiving Stations.

20230.—1909. G. MARCONI, Adelphi, W.C. Good conductors are placed on the surface or just above or below the surface of the ground beneath the horizontal antenna and parallel to it where the current is a maximum.

Production of Long Stable Electric Arcs.

22715.—1909. BADISCHE ANILIN UND SODA FABRIK, Ludwigshafen. The air or gas is passed into the tube or furnace through a hollow electrode upon the surface of which the starting point of the arc is caused to move about.

Flash Lamp for Signalling.

21702.—1909. J. S. BARNETT, Worcester. Four incandescence electric lamps are mounted upon a brass plate in such a manner that their negative terminals all make contact with this plate. The brass plate is fixed to a board which carries two brackets in one of which four dry cells are placed, one for each lamp. Each terminal of the cells is provided with a spring clip adapted to engage with clips on the bracket which forms terminal for the cells. In order to renew a cell the clips on the cells are disengaged from the clips on the bracket. Each lamp is connected in circuit with its own particular cell and each circuit is independent of the others. The number of lamps in use at one time may be varied. The usual quick acting shutter is provided for transmitting the flashes.

Receiving Messages by Wireless Telegraphy.

24388.—1909. BRITISH RADIO TELEGRAPH & TELEPHONE COMPANY, London, E.C. The receiving apparatus has means for detecting electrical oscillations, means for attuning the aerial and closed circuits to the frequency of such oscillations, by varying the coupling of the closed circuits, and means for eliminating disturbing influences.

Installations of Electric Incandescent Lamps.

25288.—1909. E., AND N. R. BOOTH, Halifax. Each lamp or group of lamps is provided with a shunt circuit brought into operation by the breaking down of an insulating body. The inclusion in the series circuit of a self-induction the rise in which is secured by the rapid breaking of a shunt circuit in which the self-induction is also included ensures the breaking down of the insulating body.

Inter-communication Telephone Systems.

28462.—1909. A. ROMER, Peckham, S.E. By use of this system an ordinary inter-communication circuit can be changed into a secret one, between two stations. A key is provided at the transmitting station which when operated causes certain contacts to break and an inter-communication circuit to be established. By operation of a key at the receiving station the circuit is changed into a secret speaking circuit.

Electric Conduit Systems.

29953.—1909. H. HIRST, AND T. TAYLOR, London, E.C. In order to readily bond electric conduit systems whereby they may be efficiently earthed, two grooves are formed in each fitting where the bonding is to be affected. These grooves are side by side to form a pair. After the tubes are fitted into the couplings a staple is driven into each pair of grooves cutting through the enamel of the fittings and providing at each junction two places in which contact is effected.

Voltage Regulation of Dynamo Electric Machines.

3915.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. In order to ensure that at any pre-determined position of a voltage controlling lever the voltage across the terminal conductors of a main dynamo electric machine will always have some pre-determined value, the main field winding of the main dynamo is connected in series with the armature of an auxiliary dynamo, the current in the field winding of which is controlled by the voltage controlling lever. The main field winding and auxiliary dynamo armature are connected together in parallel across the terminal conductors of the main dynamo in such a manner that the current flowing in the main field winding is produced by the difference of the electro-motive forces in the armatures of the auxiliary dynamo and main dynamo.

Rotary Contact Breakers for Dual Ignition Systems.

6033.—1910., WECKERLIN & STOCKER, Nuraberg. One set of contacts is employed where the current is broken for the magneto primary winding. The rubbing contact is used to break the accumulator circuit, and for this purpose it is fitted on the contact breaker which revolves in the axle of the magneto effecting in connection with segments the necessary make and break of the battery circuit.

Support for Incandescence Filaments in Electric Glow Lamps.

6397.—1910. WOLFRAM LAMPEN, A.G., Augsburg. The support consists of a spring of carbon filament bent to form a loop between the eye and hook and the opposite end. The spring arm between the loop and the eye or hook is of sufficient length to enable it, when the spring is bent under the weight of the incandescence filament, to take part in tangential vibration of the incandescence filament.

Three-phase Current Arc Lamp.

6868.—1910. E. KONECKE, Cologne. The feed of each of the electrodes is effected by means of a separate motor switched into the corresponding phase conductor and controlled by a current and pressure winding. This makes the feed of the single electrodes independent of each other.

Change-over Switches for Electric Lighting Systems for Railway Carriages.

7469.—1910. J. STONE & COMPANY, Deptford. A vertical solenoid is employed in the electro-magnetic battery for operating the switch. It is so arranged that the core makes a quick upward movement and when released falls by gravity. This ensures a quick operation of the change over switch which need not be arranged to change over the batteries at every operation, but only as required.

Cut-Outs for Overhead Conductors.

7799.—1910. J. W. NOVAK, Pittsburg. The object is to provide a trolley wire circuit with a cut-out adapted to break the circuit through a grounded section of the trolley wire and to furnish simple means in connection with each section for giving an audible and visible signal at a power plant or repair station whereby the situation of a break in the trolley wire can easily be determined. The central member comprises a pair of parallel plates between which a shoe is arranged, the lower edge of which constitutes a transfer rail while the upper edge serves as a contact plate for the pivotally-mounted end members.

Electric Switches.

8418.—1910. A. P., G. C., AND P. A. LUNDBERG, Islington. This is a two-way switch which has an additional and insulated terminal which serves to receive and connect electrically the end of one of the supply leads with an end of one of the leads connecting the two switches of the two-end switches in a two or more point system of control.

Prepayment Electricity Meters.

8922.—1910. CHAMBERLAIN & HOOKHAM, LTD., AND W. S. SPRAGUE, Birmingham. Both pallets of the escapement are capable of movement independently. The whole escapement is movable to allow of the escape wheel being forced backwards. Both the pallets are made double so as to operate as a subsidiary escapement.

Electrical Signalling Apparatus for Pits.

9164.—1910. C. SNOW, AND J. E. RADLEY, Hemsworth. A switch box and battery are mounted at the pit mouth and the pit bottom. The boxes are fitted with sliding keys each of which is provided with sliding arms engaging on one side with a continuous contact plate provided with a wire terminal, and on the other side with one of a pair of separate contact plates. The separation of the contact plates causes a long break between the successive rings so that code signals may be given if required.

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TRAFFIC RETURNS AND ACCOUNTS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

Line.	Traffic Returns per week.			Increase or decrease.		Mile of track open.		Accounts for past year.							Cost per car mile.
	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Sept. 28	1,487	1,505	— 18	— 68	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2,001	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Sept. 25	1,053	1,063	— 10	+ 688	24·089	24·089	—	—	—	—	—	—	—	—
Birmingham Corporation	Sept. 24	6,746	6,683	+ 63	+ 2,338	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29¼	29¼	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Sept. 24	5,158	5,043	+ 115	+ 4,261	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Oct. 2	1,063	959	+ 104	+ 177	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Sept. 30	6,320	5,913	+ 407	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Oct. 1	1,404	1,368	+ 36	—	19¾	19¾	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Oct. 3	440	271	+ 169	+ 155	6¾	6¾	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Sept. 24	5,688	5,255	+ 433	+ 3,832	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	‖ 5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Oct. 2	3 020	3,048	— 28	+ 165	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Sept. 29	501	522	— 21	+ 1,678	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Sept. 16	1,725	1,715	+ 10	+ 3,394	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Sept. 30	166	161	+ 5	+ 126	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Sept. 30	5,869	5,668	+ 201	+ 1,652	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Oct. 1	1,108	987	+ 121	+ 939	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Sept. 25	18,429	17,290	+ 1,139	+ 15,834	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Oct 1	2,754	2,579	+ 175	+ 3,635	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Sept. 28	135	135	—	— 186	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Sept. 28	1,328	1,338	— 10	— 582	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Sept. 25	1,393	1,389	+ 4	+ 162	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Sept. 21	42,349	38,872	+ 3,477	+ 134014	132½	124	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100		—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Oct. 1	10,567	10,020	+ 547	+ 8,089	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Sept. 25	17,483	16,970	+ 513	+ 6,468	24¼	24¼	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2¾	2¾	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Sept. 24	3,824	3,898	— 74	+ 1,042	60½	59½	„ 31	211,085	46,203,104	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 6	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 16	2,046	1 809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 20	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Sept. 25	5,962	5,643	+ 319	+ 9,222	40	39¾	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Sept. 21	1,139	1,108	+ 31	+ 634	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 10	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Sept. 24	949	936	+ 4	+ 235	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	— 97	+ 1,985	27	14·7	Mar. 31	122,891	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 2	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. h Half-years' figures.

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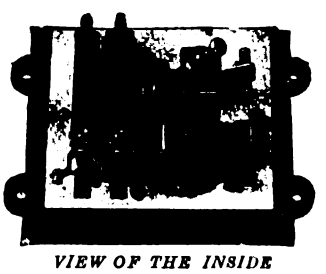

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Ladders and Steps.
Heathman, J. H., & Co., Parson's Green, S.W.

Lamp Columns for Arc Lighting.
General Electric Co., 71, Queen Victoria-street, E.C.
Johnson & Phillips, Old Charlton, Kent.

Lamps: Arc & Metal Filaments.
British Thomson-Houston Co., Rugby.
British Westinghouse Electrical and Mfg. Co., Manchester.
Edison & Swan United Electric Light Co., 36 and 37, Queen-street, Cheapside, E.C.
Foster Arc Lamp and Engineering Co., Wimbledon, S.W.
General Electric Co., 71, Queen Victoria-st.
Johnson & Phillips, Old Charlton, Kent.
Union Electric Co., Park-street, Southwark, London, S.E.

Lampholder Makers.
Dorman & Smith, Ordsal Station Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
General Electric Co., 71, Queen Victoria-st.

Lead-Covered Cables.
Callender's Cable & Construction Co., Hamilton House, Victoria Embank't, E.C.
Johnson & Phillips, Old Charlton, Kent.
London Electric Wire Co., Anchor Works, Playhouse-yard, E.C.

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THE
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An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Paris and its Electricity.

Paris, in a few years to come, will be one of the most interesting electricity centres in Europe, for big things are in contemplation. As regards distribution within the city, that has now been placed in the hands of one organisation, which is under the obligation of having a complete scheme in working order by 1913. The work of laying down the new mains will have been accomplished very shortly. The company will then have to erect and equip two additional generating stations, one north and one south, besides greatly improving the present equipment of the existing establishments. As regards the new stations, there will be 10 generating sets, seven for the north and three for the south. The prime movers will be steam turbines, using superheated steam to 300° C., with a consumption of 3·7 kilos per effective horse-power, and cooling water at 15° C. The five already ordered are of the Brown-Boveri-Parsons type. They will be direct-coupled to two-phase alternators of 10,000 kw., 12,300 volts, 412·3 periodicity, and to two direct current generators of 220 volts, mounted on the same shaft and utilised respectively for exciting the alternator and for driving the motor for the condenser. Each set will weigh 300 tons, and measure about 65 ft. in length.

Supply of Motive Power.

Apart from this, there is the immense scheme of Messrs. Blondel, Harlé and Mahl for bringing hydro-electric power from the Rhone to Paris, which has already been referred to in these columns, and has now been adopted by the Paris Chamber of Commerce. The Chamber had to decide between two projects for carrying out this gigantic task. That of M. Boissonaz provided for the erection of three hydro generating stations below the falls of Bellegarde, and the other of M. Blondel, which requires only one huge station at the foot of the falls. The Rhone at this point runs in a narrow gorge and is of a torrential character. For regulating purposes a barrage 229 ft. high will be built above Bellegarde. This will have the effect of forming a lake of over 2,000 acres and of fair depth. It is estimated the flow will furnish a minimum of 120,000 h.p. per second, or an available average of 200,000 h.p. It is proposed that half of this output should be set aside for local consumption and for distribution to centres along the line of route, the balance being conveyed to the capital.

The Equipment.

Three-phase alternators generating current at 12,000 volts will be used, the current then being stepped up to 150,000, and transmitted at that tension, in the case of Paris itself over a distance of about 250 miles. The only difficulty foreseen is that relating to insulators, but it is held that these will soon be overcome. It is proposed to use two transmission lines, each traversing a different line of route, so as to minimise risks.

Profit and Loss Account.

It is estimated that the capital expenditure will amount to £3,200,000. The annual expenditure is put down as: Interest at 5% and depreciation, £250,120; working charges, £59,820. The annual income is estimated at £470,600 for 395,000,000 kw. hours sold in Paris, and £128,000 for current sold locally, thus leaving a surplus of £294,060. This, of course, means that current will be sold at an exceedingly low figure, not only to large users, but to small people, who would have cheap power available for use in workshops and for home industries. As for the demand in large quantities, this is likely to increase to an enormous extent in the immediate future, as shortly all tramways in Paris and the department of the Seine will be electrified. It is almost practically settled that the circular railways, and probably all suburban service for a distance of between 15 to 20 miles out, will be worked by electricity. Even admitting that the above calculations, both on the expenditure and income sides, are optimistic, it is apparent that the Rhone-Paris scheme offers splendid possibilities, and should place the city in an exceptionally advantageous position.

Waste Heat.

A most interesting experiment is likely to be carried out at West Hartlepool, where the Corporation is entering into arrangements with the Seaton Ironworks Company to take all the waste heat from the company's furnaces and convert the latent power into electricity. It is said that the scheme will involve an expenditure of close upon £20,000. Although, of course, the utilisation of waste heat from furnaces for the generation of electricity is no new thing, this is, we believe, the first time in which a municipality has adopted the system.

Our Export Trade.

Those who doubt the reality of trade revival must be rather nonplussed by the Board of Trade returns for the month of September. We find, for instance, that the increase of imports over September of last year is £2,124,120, and of exports £4,507,203. Coming down to particulars, it is seen that the increase in export of electrical goods is no less than £279,889, which is certainly excellent, especially when we remember that home trade itself is fairly on the boom. It may be said that in some instances prices are cut rather fine, but even in this direction there is improvement, and matters will soon right themselves. The great thing now that trade is on the upgrade is to put as much energy as possible into pushing our advantages at home and abroad.

GERMAN ELECTRICAL HOUSES.

It is observed in an influential German organ that it is an error to think only of the larger apparatus when the electro-technical industry of the country is named. Besides the few giant houses that dominate the larger industries, there are many small ones that undertake the production of special goods, such as the manufacture of dynamos, cut-outs, meters, cables, wire, insulating material, etc. These industries are spread over the whole German Empire, whereas the exploiters of the large contract businesses are mostly concentrated in or near Berlin, *i.e.*, as headquarters. Such is natural. The special lines require more intimate intercourse between buyer and seller than is convenient, if possible, under the bureaucratic control inseparable from the conduct of large corporations. The number of workmen engaged in the electrical business in Germany is estimated at 125,000, of which 55,000 are allocated to the production of special apparatus and goods. The total annual production is estimated at 325,000,000 to 350,000,000 marks, of which about 45% is attributed to electro-technics. In respect to exports, these are largely encouraged by the establishment of branches abroad. The inland trade is largely influenced by the financial participation of the large houses in the smaller businesses, which, of course, frequently obviates all idea of competition.

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HAMPSTEAD ELECTRICAL EXHIBITION.

An exceedingly interesting exhibition, extending over five days, was held last week at the Hampstead Public Baths, Finchley-road, the object being to bring to the notice of householders in Hampstead and district the many uses of electricity in the home. The opening ceremony was performed by the Mayoress, who was accompanied by the Mayor and Corporation, a large company being present.

Councillor Holtzapffel, in asking the Mayoress to open the exhibition, said that the Municipal electric lighting undertaking was started in 1894 with only 13 consumers. They now had 7,300, and were about to lay down further expensive plant with a view to meeting the increasing demand, and also producing the current more economically.

The object of that exhibition was to bring home to the residents the desirability of using electricity—not only for lighting, but for a number of other purposes. Around them were electrical appliances, the use of which would take them completely through the day. There were electrical sweepers, which would sweep the carpets without noise or dust; they could have an electric bath; at breakfast they could use an electric stove for boiling the kettle, or toasters for making toast on the table; the ladies could do their own ironing with electric irons, which heated without delay, and they could also heat their hair curlers; the dinner could be cooked by electricity more economically than by the fire, and the cook would be pleased, the mistress would be pleased, and, not least, the master would be satisfied, and after dinner could light his cigar by electricity; there could be music from the electric piano, the rooms could be ventilated and warmed by electricity, and when they retired the beds could be warmed with electric bed-warmers.

After this very business-like oration, the Mayoress declared the exhibition open, and, by touching a button, turned on the lights and set the machinery in motion. Councillor E. S. Payne, in moving a vote of thanks to the Mayoress, said the object of the exhibition was to demonstrate that electricity could be economically used, not only for lighting, but for all manner of domestic purposes. They were a long way behind Berlin in the use of electricity, but the Hampstead Borough Council, by an extended use of it at a decreased cost, hoped to make Hampstead the most desirable suburb to live in.

Councillor E. A. O'Bryan seconded the motion.

The Mayor, in replying on behalf of the Mayoress, said that in 16 years of its existence the electric lighting undertaking had not only cost the ratepayers nothing, but had paid over £12,000 in relief of rates, and an increase in the consumption of current would add more profit to the undertaking.

The Baths for the time being were converted into two large halls for the accommodation of the various exhibits.

Messrs. Siemens Bros. & Company, Ltd., Caxton-house, Westminster, and Messrs. Siemens Bros. Dynamo Works, Limited, had a very extensive exhibit, comprising the Stannos Wiring System, "Holophane" glassware, "Tantalum" lamps, heaters, cookers, ovens, toasters, radiators, kettles, irons, etc. Some idea of Messrs. Siemens' exhibit may be gleaned from our illustration.

Messrs. Duncan, Watson & Company, 62, Berners-street, London, exhibited the Santo electric vacuum cleaner. There are several makes of vacuum cleaners upon the market; the Santo has only lately been introduced, and will undoubtedly occupy a foremost position when it becomes better known.

Messrs. Eastman & Son, the well-known dyers and cleaners, demonstrated the uses of electricity in their particular branch of trade, a number of girls being seen at work with Eastman and Warne's patent electrically-heated apparatus for goffering, etc. Messrs. Purcell & Nobbs exhibited Electrovl Radiators; Rashleigh, Phipps & Company, heating and cooking appliances; Eastman & Warne, electric heaters of the convector type; Messrs. Adams, Watkin & Company demonstrated the usefulness, combined with economy, of their "Watkin" Switch. It may also be mentioned that this switch was fitted to the show-board of Messrs. Siemens' stand. Other exhibitors included The Berry Construction Company, Ltd., Messrs. Drake & Gorham, the Holmquist Electric Company, Ltd., Olgonair, Ltd., and E. F. Moy, Ltd.; and the Hampstead Electricity department, together with a number of local tradesmen who supply fittings and accessories. Not forgetting the catering department, where everything was cooked electrically.

Mr. H. G. Cottam, Borough Electrical Engineer, and Mr. E. Sayer (assistant Electrical Engineer), who were responsible for the organisation of the exhibition, are to be congratulated upon the success of the exhibition, which cannot fail to increase the popularity of electricity.

SHEFFIELD AND THE ELECTRIC FURNACE.

In his installation speech at the Sheffield Cutlers' Hall, the Master Cutler, Mr. Alderman Senior, referred to electro-metallurgy, especially in connection with the production of high-class steels. H. said he would like to make one or two remarks in connection with the steel trade, particularly about incidents which occurred last week at Buxton. "It appears to me," he went on, "that some members go to the Iron and Steel Institute meetings simply for advertisement. We have cause for thankfulness in Sheffield that we learnt how to make the best tool steels before chemistry was known; and that knowledge still remains with us. I will candidly admit that chemistry has done a great deal, and I hope it will do a great deal more in the future."

One paper given at the recent meeting was on electrically refined steel, and a member stated, as reported in the "Sheffield Telegraph": "The adoption of electric refining will cause some readjustment in the steel trade. As soon as the Sheffield steel-melter has become acquainted with the process, and accustomed to the working of electric furnaces, electrically refined steel will largely replace ordinary crucible steel. This has already occurred in Germany and America, where electric furnaces are used to make all classes of special and high-speed steels, the usual practice being to refine metal from a basic open hearth furnace."

If he had possessed a practical knowledge (said Alderman Senior) he would not have made that statement.

Another said: "From an economical point of view, the electric furnace could easily compete with the crucible. The next question was whether the quality of the product was equal, and he thought it must now be admitted that for practical purposes it was so. There might be some very special classes of steel which could only be produced from very carefully selected materials melted in a crucible, but for 90% of the purposes for which tool-steel was required electric steel, made by any of the well-known furnaces, met all the conditions."

"I thought he would have known better," was the Master Cutler's comment on this. He next quoted the remark of a practical man at the Technical Committee meeting, that he had tried the electric furnace, but could get as good results from the best Siemens Martin and Bessemer, and in the majority of cases better, than from electrical steel, but it will not compare with the best crucible tool-steel.

A great number of similar statements were made some 55 years ago, when the Bessemer process was first invented. Then it was said that the best crucible cast steel trade was doomed, and this prophecy had been indulged in scores of times since. In spite of this, that trade had increased by leaps and bounds, and continued to flourish. It would be noticed that the firms that stocked the best irons were the firms that are doing the best and largest businesses. The best markets Sheffield had for best tool steel were Germany and America, and this in spite of their sciences and protective tariffs. "This," said the Master Cutler, "is due to the fact that we made the best tool steel before chemistry was known in the steel trade."

He saw electric steel melted in 1879 at Millwall by Dr. Siemens, in the presence of some hundreds of steel men. Ever since electric steel was commercially made, large quantities had come to Sheffield for testing and experimental purposes.

As to results, he quoted the words of one well-known, practical, Sheffield steel manufacturer:—

> I have tried to make it answer—I have humbugged my men when it didn't give the results required, but without effect. I do this because I know if it was of any good it would be no use my fighting against it; but I came to the conclusion that it would never answer for tool steel purposes.

He was reminded of the story of a melter. He was a worldly man, who had the good fortune to marry a good Christian girl. She was troubled about her husband's moral condition, and asked the minister to have a word with him, which he did. The good man, in the course of conversation, told him the Bible narrative of Jonah and the whale, then of Daniel in the den of lions, and finally about King Nebuchadnezzar ordering the furnace to be heated seven times hotter than it was wont to be. When the melter heard this, and that all the people in the furnace came out alive, "What," he said, "seven times hotter than my furnace?"

"Yes," replied the minister.

"Then I shan't believe the fish tale now," said the melter.

Alderman Senior insisted that if they were going to make good steel, they must use good raw materials—inferior materials would only make inferior steel. From past experience, if an iron analysed very pure, he looked upon it with suspicion, and always inquired what it was made from. If its pure condition was due to artificial means adopted to extract its impurities, it followed that the nature or body was extracted or impoverished to some extent. In the words of a simple Sheffielder, "You cannot make a silk purse out of a sow's ear."

This part of the speech has called forth a certain amount of local comment. One steel maker pertinently said that he perfectly agreed with the Master Cutler that if you want good material out of a melting-pot—you must put good material in, and that the same remark applies equally to an electric furnace. But, he added, the old saying, "If you put the Devil in the pot (or in the furnace either), you will get the Devil out," is perfectly true; but if during melting processes you have refined him somewhat, he is certainly a better Devil than he was before, even if not quite converted.

It is a most dangerous mistake for Sheffield steel-makers to rely upon what they have done in the past, instead of making themselves thoroughly conversant with every new process that is put before them.

Sheffield's reputation has been made by manufacturers realising that they have competitors, and that whatever comes along from such outside competitors, they must be prepared to go one better.

Mr. J. H. Heap, a director of the British Mining and Metal Company, Ltd., in an interview with the "Sheffield Telegraph," pointed out that although Siemens invented the electric furnace many years ago, it is only within the last few years that it has begun to assume any practical importance, the reason being that steel was being manufactured satisfactorily by older methods. The case is quite different with these special products, which could not be made until the electric furnace was applied to them.

"Do you claim that, no matter what material you put in the electric furnace, what comes out must be the best steel?"

"Put in that broad, crude way," said Mr. Heap, "I would not make such a claim, but it is certainly a claim of the champions of the electric furnace that one is able to start with much more impure material than one could do working by any other process, and yet arrive at a result equal to that which could be secured by other materials. It is an important fact to remember in this connection that the Sheffield steel trade is not endangered by admitting the claims of the electric furnace. It seems to me that some of the prominent men who take an interest in the subject have been needlessly alarmed. It is obvious that anyone who is interested in installing the electric furnace must find a suitable locality and ready capitalists. It is certain that Sheffield has both the money and the brains for the utilisation of the electric furnace. Indeed, the city has already proved that it is not going to take up any attitude of hostility to this appliance. Some of the most enlightened firms of the city have already displayed a willingness to give it a trial no matter what it may mean as regards the replacing of old methods and plant. For instance, electric furnaces have already been installed at the works of Messrs. Vickers, Sons, and Maxim, Messrs. Edgar Allen & Company, William Jessops, Ltd., and Thomas Firths, Ltd."

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"One realises," said Mr. Heap, "that the value of the equipment of crucible steel works does not bear so large a proportion to the value of the output as is the case in most large industries, consequently the proprietors of crucible steel works would be especially short-sighted if they were to take up an intolerant attitude towards the electric furnace.

"The chief advantages which the electric furnace has over the older methods of steel making," said Mr. Heap, in reply to a question, "are that the electric furnace can produce a good quality steel, starting with a commoner material.

"It seems to me," went on Mr. Heap, "that events are proving that before the electric furnace has reached perfection, it will have influenced the trade in grades of steel other than crucible steel, and, of course, these other grades are necessarily not of so fine a quality as crucible steel. The most obvious use of the electric furnace and the purposes to which it is now being put in the most conspicuous way are to produce a steel equal, say, to the best acid open hearth steel.

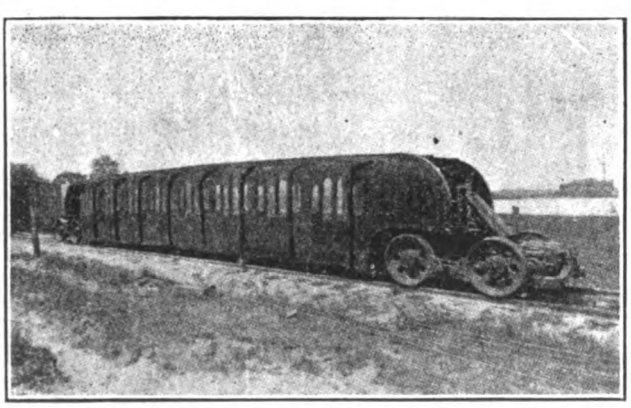
"The electric furnace in a country like ours cannot compete with the existing methods in manufacturing either pig-iron or the common grades of steel. But the cost of producing good qualities of steel other than crucible steels rises at a very rapid rate as compared with the cost of an average quality of such steel. The reason for this is that when one is limited by stringent requirements in such classes of steel, one must either start with an excellent grade of material or must take special pains in refining; and it is just because of the great additional costs involved through either of these two courses that the electric furnace can be substitued with economy.

"What has, therefore, been realised very strongly is that the electric furnace can advantageously come in so as to relieve manufacturers when making what I may call the finest non-crucible steel of the necessity of starting with exceptionally pure materials, and also of the necessity of carrying on refinement to the extraordinary degree which obtains in the present furnaces; replacing those steps by taking a common grade steel made from common grade materials and refining so as to give a good quality of steel."

NEW ELECTRIC SUB-WAY CAR.

A new development in the design and construction of electric sub-way cars has been introduced on the Cleveland Underground Railway, Cleveland, Ohio.

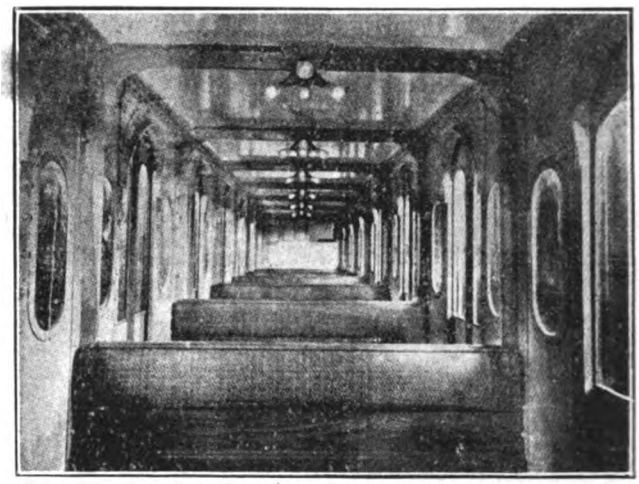
As will be seen from the two illustrations, for which we are indebted to the "Electrical Review and Western Electrician," of Chicago, the car possesses considerable novelty in plan. It is, it appears, the invention of Mr. A. B. Du Pont, and its essential features are its low centre of gravity and small cross-sectional area. One car has been built



and is now being used for demonstration purposes on an experimental track at East 105th-street and Quincy-avenue, Cleveland. This track is 2,400 ft. long, and includes a curve of 49 ft. radius and a dip of 6 ft. in 150 ft. At one end a frame building, representing a subway, has been built over 200 ft. of the track; the entrance to the building allows but 1 in. clearance all around the car, yet so steadily does it run, owing to its low centre of gravity, that the car has never touched the entrance, although it has been run through it 100 times at a speed of 25 miles an hour. The steadiness is very apparent while the car is taking the dip or rounding the curve.

The small cross sectional area of the car allows a material reduction in the size of the subway. At the experimental track the subway measures 7 ft. 6 in. from top of rail to roof and 13 ft. side to side, this gives room for two tracks. As the area is but 40% of the area of the New York subway, and the cost of construction is approximately proportional to its cross-section, it follows that this will effect a saving in the cost of construction, and the ventilation problem will also be that much less expensive, according to the promoters. Besides the saving in mere cross-sectional work, the depth is so comparatively shallow that it would enable the contractor to avoid the greatest obstacle the subway builder encounters, namely, the sewers. Moving sewers was no small part of constructing present subways.

The appearance of the car is shown on the two illustrations. It is built of steel throughout, with the exception, of course, of cushions on the seats, three by three by three-eights angles and three-sixteenths-inch plate composing most of the structure. The weight is carried chiefly by four three by five by one-half angles, two at the top and two at the bottom of the sides of the car. The car has a camber



of 4 in., which will probably be reduced in subsequent cars as the full load produces no material deflection. The bottom of the car is but 6 in. above the top of rail. Over all dimensions it measures 58 ft.; centre to centre of trucks, 48 ft.; inside to inside, 5 ft. 6 in.; floor to ceiling, 6 ft. 6 in.

It will be noticed in the illustration that in order to reduce the width it was necessary to put the wheels outside the bearings, reversing the usual railway practice. The track is standard 4 ft. 8½ in. gauge. It being impossible to put the ordinary brake rigging with its levers on a car that has no room available underneath, the problem was solved by putting a comparatively large brake cylinder between the brake beams, attaching the cylinder to one beam and the piston to the other, a ½ in. movement thus gives all the braking power required. Direct air at 65 lbs. is used for its operation.

A trolley wire is in the middle of the track, the trolley being held in position by a spring so that it is impossible for it to leave the wire. It is intended to operate the cars in trains with multiple controllers, the drawhead being shown in the illustration about the centre of the controller. The car has a 75 h.p. motor.

POWER AT NIAGARA FALLS.

The Sentimental Aspect of Hydro-Electric Enterprise.

(From Our New York Correspondent.)

The fact that thousands of acres of timber are being cut in Newfoundland at the present time in order to feed the new pulp mills at Grand Falls has revived in an acute form in this State of New York the old, old question of the conflict between commerce and nature. We have no sentimental affection for Newfoundland, and our paper mills are cheerfully co-operating in the work of stripping that island of its timber, but the case of Newfoundland has formed a convenient peg on which to hang once more the

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indictment that the picturesque glories of Niagara Falls are being sacrificed to the utilitarian rapacity for more hydro-electric power.

As a matter of fact, the power-producing capacity of the Falls shows an average, over a period of 30 years, of 4,914,000 horse-power, and all the power companies combined are only taking from it an aggregate of some 600,000 horse-power, and the difference in the flow of the river only amounts to the fraction of an inch.

It is just 20 years since the first of the power companies—the Niagara Falls Hydraulic Power and Manufacturing Company—began operations. Their original franchise or charter gave them the right to use 10,000 cubic feet of water per second, or 100,000 h.p., while the Niagara Falls Power Company was permitted to take 17,200 cubic feet per second, or 200,000 h.p. The Burton Act, however, together with the Falls Treaty between the United States and Great Britain limited the two companies to a take of 15,600 cubic feet between them. On the Canadian side of the river the Canadian Power Company is permitted to divert 8,600 cubic feet per second, or 100,000 h.p.; the Ontario Power Company, 11,700 cubic feet, or 180,000 h.p.; the Electrical Development Company, 10,750 cubic feet, or 125,000 h.p., and the Niagara Falls Park and River Railway Company, which is now a part of the International Railway Company system, 400 cubic feet. In addition, 10,000 cubic feet has been allotted to the Chicago Drainage Canal, 1,100 cubic feet to the Welland Canal, and 1,200 cubic feet to the Erie Canal.

This makes 31,450 cubic feet on the Canadian side, and 27,200 feet on the New York side, which has been cut by Congress and the Treaty to not to exceed 20,000 cubic feet, and 12,300 for the other purposes mentioned, or a total of 79,950, which is reduced at least 7,200 cubic feet by the Treaty. The total amount of power to be developed by the five companies under their original franchise is 705,000 h.p., but the Niagara Falls Power Company has never built the second tunnel contemplated under the franchise from the New York Legislature, and its producing capacity is practically reduced one-half, so that as the matter now stands the power companies can only develop 605,000 h.p.

At the present time the Niagara Falls Power Company owns two miles of continuous river frontage and a total of 1,100 acres of land, its power plant cost $20,000,000, a terminal railway runs through its lands, and it has located some 30 industries, which take about 60,000 h.p. The company's maximum output is 106,000 h.p., and it transmits 46,000 h.p. to Buffalo, the Tonawandas, Lockport, Olcott Beach and Fort Erie, so that it has no more power to sell.

It is estimated that the annual output of the company's plant is equal to about what 846,400 tons would produce in steam power, or 2,300 tons daily. The American intake canal is 1,200 feet long, from 119 to 194 feet wide and 12 feet deep; the Canadian intake canal is 271 feet long, 282 to 586 feet wide, and 14 feet deep. The American tunnel is 7,481 feet long, 21 feet high, and about 19 feet wide, running 230 feet below the surface; the Canadian tunnel is 2,165 feet long, 25 feet high, and about 19 feet wide. The American wheel pit is 424 feet long, 18 feet wide and 177 feet deep; the Canadian wheel pit is 564 feet long, 18 feet wide, and 160 feet deep. The 10 generators in power-house No. 1 have a capacity of 5,000 h.p., 11 in power-house No. 2, with a capacity of 5,500 h.p. each, and those in the Canadian power-house have a capacity of 10,000 h.p. each.

The official figures compiled from exhaustive tests by Professor Winthrop Spencer show that in 32 years the flow of the river has varied from 158,500 to 292,000 cubic feet per second, and that the average flow was 204,000 cubic feet per second. It is only for a few hours when the wind blows strongly up the river that the minimum flow occurs. A strong wind down the river makes the maximum flow. Reducing the cubic feet to horse-power, it is found that the average capacity of the Falls was 4,914,000 h.p., varying from 3,818,000 h.p. to 7,033,000 h.p., and the operations of the power companies have only diminished the rate of flow by such an infinitesimal degree that the most delicate instruments could only be found to record it after months of careful and minute observation.

So whatever may or may not be happening in Newfoundland, it is clear that commercialism is not putting in any of its deadly work at Niagara Falls.

PATENT LAW AND PRACTICE.

The Law and Practice Relating to Patents and Designs, by David Fulton, A.M.I.C.E., of the Middle Temple, barrister-at-law. Fourth edition. London: Jordan and Sons, Ltd. 15s. net.

Thornton on Patents, British and Foreign, by A. A. Thornton. London: Chas. Jones, Ltd. 21s. net.

Foreign and Colonial Patent Laws, by W. C. Fairweather, M.A. London: Constable and Company, Ltd. 10s. 6d. net.

Compulsory Working and Revocation of Patents, by Ernest Lunge, of Gray's-inn, barrister-at-law. London: Stevens and Sons, Ltd. 3s. 6d. net.

The passing into law of the Patents and Designs Act, 1907, has given rise, as might have been expected, to a heavy crop of literature upon that subject, both on the legal and on the practical side. We have before us at the present moment four books thereon—each covering its own sphere—and it can safely be asserted that these are but a tithe of the books that have already appeared, bringing the exposition of the law and practice of patents and designs abreast of modern requirements. It involves no small degree of courage on the part of an author to tackle a work upon such a subject as this, for the mass of legal decisions growing yearly has now reached an enormous size; but there is consolation to be found in the fact that the consolidating and amending Act now in force has already served to simplify much that was formerly obscure and doubtful, and has also brought about the rectification of a great deal that was incongruous and unsatisfactory. The great features of the Act (which though associated with the name of the present Chancellor of the Exchequer, was in process of evolution long before his advent to the Board of Trade, being inspired by the Chambers of Commerce and other authorities, who have been agitating for many years for amendments of the law) are, of course, the increased powers of the Comptroller to deal with minor matters, the protection afforded to British manufacturers against piracy from abroad, and the consolidation already referred to.

Taking the books in order which lie before us, the first to claim review is Mr. David Fulton's "Law and Practice Relating to Patents and Designs." This is a fourth edition of one of the best known and most reliable of the legal handbooks known to the profession. The learned author who, in addition to being a member of the Bar enjoying an extensive practice, is also an Associate Member of the Institute of Civil Engineers, deals with the subject on a scheme following that adopted in former editions of his work and traversing the entire field covered by the new Act. The edition appears at an opportune moment—the Courts having now discussed and interpreted the new portions of the Act and having taken occasion already to modify and explain the effect of some of the older decisions. The author, therefore, by not being precipitate, but by waiting to allow the Act to "settle" before going to press, has placed himself in the position of being able to record actual practice and cite reported rulings, instead of having to rely upon mere speculative comment. As he points out, there may now for the first time be said to exist a Code of Patent Law comprising the effective sections of the Statute of Monopolies, the Act of 1907, the Patents Rules of 1908, Order LIIIA of the Supreme Court, and the International Convention. All this is fully and comprehensively dealt with in the volume before us, which is divided into two parts—one covering patents and the other designs—to which are added appendices setting forth the statutes and rules referred to, and (which are of the greatest value) a complete set of precedents of agreements, assignments, licences, mortgages, etc., which must prove of service to the practitioner and his client alike. With regard to the general arrangement of the work, Mr. Fulton has followed the practical line of devoting a separate chapter to each main point, *e.g.*, "Who may be a Patentee" or "Opposition to Grant of Patent," embodying under each heading the law, the practice, and their effect. It is not necessary to add more than this, that Mr. Fulton's work will continue to rank as one of the best.

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"Thornton on Patents—British and Foreign," by A. A. Thornton, consulting patent agent, is a volume claiming to embody "the Pith of Patent Law and Practice in the United Kingdom and Abroad, with Rules, Forms, Examples, and Precedents." With this description we are in no mood to quarrel. The volume is of the practical rather than of the legal type. The author tells us that he has written his book, firstly, for the patentee and the public generally; and, secondly, for those solicitors whose busy general practices prevent them keeping in touch with a special branch of law for an interpretation of which they are only occasionally called upon. It is true that there are, and always will be, a large number of inventors who, for various reasons, wish to deal with their own patent applications (particularly in the early stages). How far this is to be encouraged in their own interests is a doubtful question; there is an old adage concerning the status of the man who acts as his own lawyer which is eminently applicable in many instances to the inventor who acts as his own patent-agent; and we are glad that the present author has the courage to point this out, risking the obvious retort that it is just what might be expected from a patent-agent. Now, this is one of those foolish ideas which do take hold of the public mind: the truth being that there would be less work for lawyers and patent-agents, too, if people would not get themselves into trouble before consulting them. Mr. Thornton has done all that an author can do to make things clear for his readers: as he says, he has been careful to make his book a "safe" book, so there are no discussions on dangerous and subtle topics. His collection of cases, if meagre, is well-chosen and representative of the issues determined by the Courts. The "Judicial Dicta" given in Chapter XVII. will be much appreciated; but the part of the work which will probably be of greatest value is the collection of foreign and colonial forms, whilst the notes explanatory of the documents required for foreign and colonial patent application cannot fail to be of great service to professional men. On the whole, Mr. Thornton may fairly claim to have achieved—and very well achieved—the object for which he set out, *i.e.*, not to write a work which could compete with more exhaustive works by members of the Bar, but a work that would lie between them and the mere handbook—a book which gives information simply and concisely on that branch of patent practice in which the patent agent alone has practical experience. Such a book, we say unhesitatingly, is that which lies before us.

"Foreign and Colonial Patent Laws," by Wallace Cranston Fairweather, M.A., chartered patent agent, is a volume setting forth in detail the law and practice for obtaining and maintaining patents in all countries. The author is a member of the International Association which watches over the working of the Convention already referred to above, and is, therefore, closely in touch with the changes that are taking place from time to time in the patent laws of the world. In this work each state and colony forms the subject of an independent article, and it is pointed out that that is really the only practicable way of dealing with the matter, since, as regards foreign countries, the laws vary widely, and no great success has attended efforts at unification. The laws in force in British possessions are fairly uniform and approximate closely to the patent law of the Mother Country; and whilst we share Mr. Fairweather's opinion that there is no immediate prospect of the institution of universal patents, we yet are disposed to look forward to the establishment of an Imperial Patent Law under which the various parts of the Empire shall consolidate their legislation for the convenience and protection of the British inventor. We can certainly congratulate the author of this work upon having dealt with his subject in a most exhaustive and concise manner. There is no surplusage in his book—and yet all needful points have been covered.

A little volume on "Compulsory Working and Revocation of Patents," by Ernest Lunge, of Gray's-inn, barrister-at-law, is chiefly useful for the code of practice under Section 27, which occupies the second half of the book. With regard to the first portion, the learned author has not added to its value by trotting out promiscuously his general views on Free Trade and Protection. Cutting out these, however, we have left a very able historical sketch, which goes to prove that compulsory working was the basis of our British patent system, and then the writer provides a good practical guide covering the whole working of the law and practice under Section 27. The work is essentially technical, and should prove of considerable assistance to the legal profession. The book wants an index.

LAMP HOLDERS AND CAPS.

British Standard Specification for Bayonet Socket.

The standard specification for bayonet lamp holders and caps, report No. 52, recently issued by the Engineering Standards Committee, has appeared at an opportune moment.

The advent of the metal filament lamp has brought with it a curious difficulty, and that is in regard to the fitting of any lamp cap into any holder in general use. This difficulty has been increasingly noticeable of late, and whether it is due to hasty manufacture or on the other hand to faulty gauging the result is practically the same, annoyance to the user and the possible loss of custom to the maker.

If, therefore, the lamp makers will adopt the suggestions of the committee as outlined in their specification, especially in regard to the question of the verification of their shop gauges, it should not be a difficult task to do away entirely with any tendency to non-interchangeability as between lamp caps and lamp holders of different makes and thus prove the specification a commercial benefit to the maker as well as a boon to the user. The committee, in a preface written by Dr. R. T. Glazebrook, point out that they have kept in view the great desirability of interchangeability, but that they have been most careful not to interfere in any way with invention and progress. They also express their appreciation of the courteous assistance rendered by the makers.

The present specification deals with holders for lighting purposes only, but it is understood that the effect of heat on the ordinary lamp holder is being investigated experimentally at the National Physical Laboratory, so we may shortly expect to see an addendum to the present report, dealing with lamp holders for use with radiators.

The price of the report, which contains four plates of diagrams, is 5s. 2d. post free, and it may be obtained from any bookseller or direct from the offices of the Committee, 28, Victoria-street, Westminster. It is published for the Committee by Messrs. Crosby, Lockwood & Son, 7, Stationers' Hall Court, Ludgate Hill, E.C., and 121a, Victoria-street, S.W.

HYDRO ELECTRICS IN CANADA.

"The Canadian Gazette" states that representatives of 34 municipalities, members of the Ontario Hydro-Electric Power Union, met at London, Ontario, on September 22, to consider the application of Windsor for 15,000 h.p. to export to Detroit. It will greatly lessen the cost of power to other municipalities along the line if Windsor is allowed to take this quantity of power, but to permit export would mean a reversal of the hydro-electric policy.

All delegates were in favour of Windsor getting the power asked for, but they stipulated that the profit should go to all the municipalities concerned, and that contracts should be made by the Commission so that if extra power is at any time required in the Province, exportation may cease after a reasonable notice.

The Toronto "Globe" understands that the Government, acting upon the recommendation of the Commission, is lively to seek special terms under which the existing right of export in the Ontario Power Company's charter will be curtailed. The company named is the one supplying power to the Hydro-Electric Power Commission for use in the various municipalities.

The municipalities concerned are Toronto, Brampton, Weston, Hamilton, Guelph, Berlin, Galt, Hespeler, Waterloo, New Hamburg, London, Norwich, St. Mary's, Stratford, Woodstock, Ingersoll, Tillsonburg, and St. Thomas, which have entered into contracts, and Windsor, Mitchell, Seaforth, Dundas, Amherstburg, Bothwell, Chatham, Comber, Dresden, Elmira, Essex, Leamington, Port Stanley, Ridgetown, Tilbury, and West Lorne, which have passed bye-laws.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Matters of considerable interest to electrical engineers have been much to the front in this area during the past week. One of the most important of these is the Local Government Board enquiry held at South Shields on the application of the Corporation to borrow £9,410 for extensions to the municipal electricity supply. Two of the largest ratepayers in the borough, the Smiths' Dock Company and the North Eastern Railway Company, opposed the application from the point of view of keeping the rates down, their combined rateable value being about £66,000. The North Eastern Railway is already supplied by the Newcastle-upon-Tyne Electric Supply Company, Ltd., while the other company obtains power from the County of Durham Electric Power Company. In connection with their proposed electrical extensions at their dock, they had been advised that direct current, as supplied by the municipality, was not so advantageous to them as three-phase current. The two ratepaying companies had ascertained that in 1905 the borough had been offered current in bulk from the power supply company operating in the surrounding area, at most advantageous rates, and if this offer had been accepted considerable capital expense would have been saved to the borough. Under the circumstances, a notable decision was arrived at, which should be held up as a splendid example to contestants in similar circumstances. This was to adjourn the enquiry without calling evidence, so that the interested parties should meet at a round-table conference on the matter and go thoroughly into it with expert engineers, who would present a joint report. It would be a fine thing for ratepayers all over the country if this example from Tyneside could be followed elsewhere.

Tramway Affairs.

There is a movement in Newcastle in favour of allowing blind people to travel on the Corporation tramcars free of charge, but the sentiment is not without opposition. The arguments that are used in favour of this development are that as the dangers of pedestrianism in the city have become greater since the institution of the car service, and as the blind are called upon to pay taxes for museums, art galleries, public lighting, etc., the benefits of which they cannot enjoy, it is only a fair *quid pro quo* to give them the benefit of free transit. It is probable that the matter will shortly receive official attention.

During the past week the Amalgamated Association of Tramway and Vehicle Workers, Newcastle Branch, held a smoking concert to celebrate the coming-of-age of the Association; and the local secretary in his speech laid down clearly the improvements for which the local tramway workers are agitating. These are (1) an automatic means by which the conductors can send in the money received as fares, (2) more efficient weather-protection for the motormen, (3) termination of the custom of including spare weeks and Sundays in the men's holidays, and (4) payment of new men during training.

The Gateshead Tramway Company have now opened their extended lines to Wrekenton, have extended the Bensham Bank route to the Saltwell Cemetery, have doubled the track on the Low Fell route, and have made certain much-appreciated improvements in the car service.

Gas!

By a curious coincidence, two important conventions have been held in Newcastle during the past week. The first was the half-yearly meeting of the North of England Gas Managers' Association. The president, Mr. J. Lewis, of the Newcastle and Gatsehead Gas Company, paid (if the report in the local press be accurate) a very pretty compliment to electrical industries by saying that "Competition and the demands of the public have brought about this change"—referring to the introduction of new means and methods of gas lighting—"with the result that one time independent and sometimes unobliging suppliers of a public commodity are now transformed into enterprising tradesmen." It would be interesting to electrical engineers to know the ratio of transformation. Another noteworthy phrase was supplied by Mr. W. Sutton at a meeting in the Mining Institute, after a trip by special tramcars to Elswick Ordnance Works. This was that "There is not the slightest doubt of this, that gas, properly used and intelligently applied, can knock out electricity for lighting and everything else." And after a ride on an electric tramcar!

The Association of Mining Electrical Engineers.

The second convention held in this city during the past week was the annual gathering of the Association of Mining Electrical Engineers. The proceedings commenced with a Council Meeting at 3 p.m. on Friday at Armstrong College, followed by tea and the annual General Meeting, at which important matters were discussed, and a very controversial subject—that of examinations and certificates for mining electricians—was introduced by the President, Mr. Wm. Maurice. After discussion of the paper, the members adjourned to the County Hotel, where an excellent dinner and good musical programme awaited them, and where several important speeches were given. It is proposed to give more extended notes of these two meetings next week, as very important matters were introduced. On Saturday morning a party of members and friends went down the Tyne on a tug kindly lent by the River Tyne Commissioners, to the power-house of the Newcastle-upon-Tyne Electric Supply Company, Ltd., at Carville, where the plant was inspected. After a lunch, provided by the courtesy of the company, the party proceeded to Harton Colliery and inspected the electric winding gear and other parts of the extensive electric equipment. On the return journey some of the members availed themselves of the invitation of Messrs. Reyrolle & Company, Ltd., to visit their works at Hebburn, where mining electrical switchgear was on view. In connection with these meetings a very interesting demonstration of the Holmes-Page electric detector of firedamp in mines was given by Mr. Ralph, further notice of which invention will be given later.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

At the opening meeting of the South Staffordshire and Warwickshire Institute of Mining Engineers held in Birmingham on Monday, the President, Mr. D. E. Parry, devoted a portion of his inaugural address to the subject of electricity. Mr. Parry referred to the rapid substitution of electrical for mechanical methods in mining operations. Electricity, he said, as a more useful and more accommodating agent, was being extensively installed in some of the mining districts of the country, and he had no doubt that at no distant date those engaged in mining might even depend almost exclusively upon it. By drawing the necessary energy from great central stations they would not only dispense with a great deal of expense and mechanical labour, but would also be able to do away to a great extent with the smoke nuisance.

The Electric Club.

An auspicious commencement of the session was made by the Birmingham and District Electric Club on Saturday evening with a smoking concert, held at the Colonnade Hotel, Birmingham. The chair was taken by the President, Mr. G. O. Donovan, and contributions to the programme

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were made by Messrs. Dowling, T. H. Hunter, Rowe, Sanders and Fletcher, who contributed songs, and Messrs. H. Barker, F. W. Foster, and Smith, who gave recitations. Mr. Hunter, who had arranged the programme, also acted as accompanist. The proceedings proved very enjoyable, and the opportunity was taken of the gathering for a preliminary consideration of the programme of the session. With regard to the practical side of the Club's work, a letter was received from Mr. James Findlay, of the Rugby Lamp Company, who had been asked to give another paper this session, and who stated that he had not a paper in readiness, but would be glad to address the members on any questions relating to lamp making upon which they would like to be informed. After some conversation, it was decided to ask Mr. Findlay to give a continuation of the paper read by him last session. Several members suggested that a discussion of Shades and Reflectors would be exceedingly useful, in order that the members might be in a better position to judge of the value of some specialities now on the market. Particular interest was expressed in the "Holophane" form, and it was decided that as Mr. Campbell and Mr. McKinnon would be in Birmingham shortly arrangements should be made for one of those gentlemenn to address the Club on the subject of the "Holophane" shades. A telegram was received from Mr. Innes, wishing success to the club, and it was resolved that a letter be sent to him expressing the wish of his fellow-members for his speedy recovery from the illness from which he has recently been suffering.

Birmingham Busy.

The principal electrical manufacturing firms in the Midlands are all fully employed. Siemens Brothers, of Stafford, are exceedingly busy, and the increase of business has made it necessary to extend the factory. Three new bays, each about 100 yards by 40 yards, are being erected as an extension of the erecting and winding departments.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

The joint report of the officials of the local gas and electricity undertakings in Manchester has been issued. The joint committee were convinced that so far as the prices charged are concerned each department works on a recognised principle. They have come to the conclusion that in accordance with Parliament's recent attitude on the question, each department should contribute an amount not exceeding 1% of its outstanding mortgage debt in rate aid. As the gas undertaking is much older than the electricity department, gas will be responsible for £12,127 towards the rates to electricity's £19,701, although the capital expenditure on the gas undertaking is £2,851,200, while the electricity undertaking is £2,678,700. On this agreed basis electricity appears to be paying less than its share, but it is explained that this is because about £1,000,000 of its capital is sunk in equipment for meeting traction requirements, and by special agreement with the Tramways Committee and the Council, the department cannot make any profit on this supply, so that this money is unable to earn a dividend for the rates directly, though it helps that of the Tramways Committee. Even so, the deficiency is very slight, and, it is expected, will very shortly disappear, as the gas contribution (about £50,000 per annum) is likely to remain stationary for some years to come.

As to the supply of new districts, where both supplies are demanded, it has been decided that the electricity department should continue its rule of requiring an annual gross revenue of 20% of the capital outlay on mains to such district, and that the gas department should also insist on a similar return where the requisite amount is not forthcoming for both departments, and failing a satisfactory arrangement between themselves the joint report recommends that a standing committee, consisting of an equal number of gas and electricity committeemen with representatives of the Finance Committee, should deal with the matter, such a committee looking at the question from the Corporation point of view rather than the narrower view of either department.

The Exhibition.

So far as can be seen yet, this promises to be a most successful show, and should have a very stimulating effect on trade. There will be exhibits of all kinds ; naturally, machine tools are very numerous. Many electrical firms are showing :—Ferranti, G. E. C., Wardle Engineering Company ("Streelite" fittings, etc.), Cambridge Scientific Instrument Company, Kelvin & White, Small Power Dynamo & Motor Company, and others. The Lea Recorder Company will give demonstrations of their very well-known recorder under working conditions. Messrs. Sutcliffe, of Crumpsall, Ltd., will have a fine display of fibre for all purposes, cans for textile machinery and their other specialities. Last, but not least, the ELECTRICAL ENGINEER Stand will be much in evidence. During the show, some of the best military bands will perform, and there is every prospect that the exhibition will be as much patronised by the ordinary folk in the evenings as by the buying public during the day.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Some of the most recent and important researches into the economy of electric lights are summed up in the following table. It will be seen that tungsten lamps used for direct lighting come out with the best record and that Moore lamps are of much less value.

Lighting.	Kind of Lamp.	Watt consumption per lux.
Indirect..	Open continuous current carbon arc lamp (neg. pole below)	0·188–0·303
,,	Open continuous current carbon arc lamp (pos. pole below)	0·136–0·220
,,	Open alternating current carbon arc lamp	0·339
,,	Tungsten lamp (continuous or alternating)	0·259–0·318
Direct ..	Open continuous current carbon arc lamp	0·15–0·3
,,	Carbon filament lamp	0· 5–1·2
,,	Tungsten lamp (in clear glass) ..	0·15–0·175
,,	Tungsten lamp (in ground glass) ..	0·22–0·25
,,	Moore light	0·445
Half Indirect..	Open continuous current carbon arc lamp (neg. below)	0·15–0·35
,,	Closed continuous current carbon arc lamp	0·367
,,	Tungsten lamp (continuous or alternating)	0·225–0·260

A lux means one Hefner candle per square metre of illuminated surface in a small space, such as an ordinary room, or one British candle per 12 square ft.

The Arlberg Railway.

It is intended to convert the Spullersee, which lies at a height of nearly 6,000 ft. above the sea into a reservoir for supplying water power for the Arlberg Railway. The works will raise the level of the water in the lake by about 100 ft., at the same time and increase its average volume from 2 to 13½ million cubic metres.

Vienna Trams.

The report of the directorate of the Vienna tramways for 1909 has just been issued. It is a very lengthy affair, some of the most interesting points of which may be of interest. The total length of the line was 150 miles, 125 miles being electric. There are 19 miles of steam tramways, and the balance is in course of electrification. The number of persons employed was 9,321, costing in salaries and wages about £630,000. The taking over of the tramways by the City Council has resulted in great improvement in the condition of the employés, especially in regard to housing, pensions, and better wages. The number of passengers carried was 259,480,839, as against 238,102,603 in 1908.

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Fire in Electrical Works or Places with Electric Installations.

The following is a resumé of the chief precautions recommended by the "Verband Deutscher Elektrotechnicker" in cases of fire in electrical works or where electricity is installed.

When the fire occurs or is threatened, work should proceed as usual if there is no immediate danger. The staff themselves should attend to the outbreak if possible, and the help of outsiders ignorant of electricity must be prevented at all costs. The machines should be shielded against water from fire-engine branches. Only dry sand, carbonic acid gas, and other incombustible and non-conducting extinguisher may be used on electrical machinery.

In the case of installations lamps should be switched on even if the fire occurs in the time. They illuminate rooms full of smoke far better than any other source of light, and hence afford valuable assistance in salvage and fire-extinguishing operations. Electro-motors should be switched off, but only by those familiar with them, if possible. No wire should be cut unless there is some special reason for doing so.

So long as the employés are allowed access to the premises for the purposes mentioned the firemen must have a free hand, except that they must as far as possible keep the water off all electric machinery and apparatus. If any necessity arises for interfering with transformers, etc., notice should at once be given to the electricians who must of course, be on the spot.

Open air wires carrying high voltage currents in the neighbourhood of a fire, should be left alone, as grave peril to life is incurred by unskilled interference with them. Firemen should be warned against letting their ladders or their helmets touch these wires. No stream from the hose ought to be allowed to pass within 10 ft. of a live wire at high tension. If it is indispensable to cut off the current, this must be done at the proper place, and by the proper people. Cutting of the wires is dangerous and is a practice never to be resorted to. Finally, in case of absence of the parties directly responsible, there should always be men attached to the fire brigade who have had such training as will enable them to take the place of the absentees.

When the fire has been extinguished all current should be shut off from machines, lamps, and everything else, to facilitate salvage and other operations necessarily carried out after a fire. If lighting is required for this work any electric lamps available may be put in under proper precautions.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

While the electrification of railways continues to be one of the most important problems in the whole field of electrical development, fresh impetus has been given to its discussion by the decision of the New Haven Railroad Company to adopt single-phase on the Hoosac Tunnel division, and also on its New York, Westchester and Boston lines. Official details of the plans of the New York, New Haven and Hartford show that the single-phase system at 11,000 volts is to be installed on the 25,000 ft. of double track through the Hoosac Tunnel; on the 21 miles of two and four track of the New York, Westchester and Boston line from 180th-street or Adams-street, in New York, to the corner of East Fulton-street and Columbus-avenue, thence across the present New Haven tracks to North White Plains on the north and New Rochelle on the east; on the six-track line of the Harlem River branch from New Rochelle to Morrisania, and on the four-track line from Stamford to New Haven. For the Hoosac Tunnel service five electric locomotives of the straight single-phase type will be constructed, power being obtained from a new station with a capacity of 6,000 kw. in two 3,000 kw. turbine units. In the tunnel, which has a height of 18 ft., giving 4 ft. clearance of the cars, an 11,000-volt overhead system is to be installed, and work on this has already been begun.

A Complicated Problem.

The decision of the New Haven road gives peculiar emphasis to a striking paper which was read last week by Mr. W. E. Davis, Vice-President of the Cleveland Construction Company, at the meeting at Indianopolis of the Central Electric Railway Association. Mr. Davis said that steam railways were demanding a system calling for a tremendous output of energy over long distances, and were slowly but surely feeling their way towards electrification, and even more slowly and surely overcoming the tremendous existing prejudices of all steam railway employees against electrical application; though it was noteworthy, he observed, that no steam railway to-day was complete without its corps of competent electrical engineers. He touched upon the Chicago situation, where there are upwards of 3,000 steam road sidings connected with various factories, yards and warehouses, and where, replying to the City Council's demand for electrification, the Attorney of the Chicago and North-Western Railroad asked how they should do it—500 volt trolley, third rail, high tension trolley wire, single phase, three-phase—how? Mr. Davis then went on to analyse existing systems, and declared that the greatest weakness of the single-phase is the complication brought about by the interchange of alternating and direct current in the same apparatus. On the Washington, Baltimore and Annapolis, where complications of single-grounded trolley direct current, double trolley direct current sometimes grounded and sometimes not; and the 6,000 volt grounded alternating current were placed in combination on the same equipment, the intricacy and number of parts were such as practically to condemn the apparatus from the start, and eventually the line was changed to the 1,200 volt direct current. Mr. Davis also points out that even when operating on alternating current alone, the car apparatus is more complicated than that of a direct current equipment of the same capacity, and the motors, for the same horse-power must be from 15 to 25% greater in size, thus necessitating larger axles, larger gears and pinions, and other operating parts, and causing a considerably greater weight and a consequently greater output of energy to operate the car.

Single-phase in a Snowstorm.

Nevertheless, single-phase has its points. Mr. Davis cites a case of the operation of the system in a snowstorm, where every other electric railway system and even the steam roads were out of business. "The snow," says Mr. Davis, "was 3 ft. deep on the level. No track was in sight either in front or behind the car, but a stretch of unbroken snow as far as the eye could reach, in places as high as the sills of the car itself, and the car had no snow-removing device except a small iron-plate pilot about 30 in. in height. This result was possible because the system possessed the most important factor of all, a magnificent line voltage. Time was actually made up in the run of nearly 40 miles. The deck sash had to be closed to prevent the snow, driven by the car, from filling the passenger compartment, and in passing through the long drifts the car became so dark, at 2 o'clock in the afternoon, that all the electric lights had to be turned on, yet several minutes of time were made up on this run. In the same storm, the Aurora, Elgin & Chicago third-rail system was tied up to such an extent that no car was run for nearly a day. On the single-phase line not a trip was missed, and every car was maintained practically on time."

The System of the Future.

After a glance at the New York, New Haven and Hartford and at the New York Central, Mr. Davis seeks a sign of the future, and finds the 500-volt direct-current system firmly entrenched until the next revolution in power application arrives. But new and larger railways will be built, demanding higher voltage and less losses, mechanical and electrical, and so the higher potential direct-current systems with 1,200 to 2,400 volts come into view. Then comes the question of the electrification of the trunk lines of steam railways—a condition demanding hundreds of thousands of kilowatts, crossing tracks hundreds of miles from the source of supply, with 3,000 tons' freight trains to be hauled over 2 and 3% grades. It is in this field that, in Mr. Davis's opinion, the single-phase system, or

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some modification of it, will find its own. A development of the latest type of mercury gas rectifier will allow a conversion from alternating current to direct current at frequent intervals with practically no sub-station attendance. New motors are being designed embodying a combination of alternating current and direct current principles. New discoveries are being constantly made in the line of insulation and the handling of high-tension and apparatus. One of the leading electrical manufacturers is at present attempting to perfect a 2,400-volt system with four 600-volt motors in series for each car, with indications that the result will be favourable. The most serious drawback at present seems to be the matter of commutation of generating units. At present it is customary to obtain 1,200 volts by operating two rotary converters in series. The operation of four rotaries in series for 2,400 volts would be an undesirable complication, and as in several instances in Europe currents of 2,000 volts direct current are being commutated with success, the writer sees no reason why the 2,400-volt system should not be a feature of the future.

Boiler and Engine Room Economies.

At the recent convention of the Pennsylvania Electric Association, Mr. T. C. Coghlan read a paper in which he summarised the most important points to be watched in order advantageously to promote central station economy. He especially emphasised the need of skilled men to operate the furnaces, urging that this was a point where intelligence was of far more importance than mere strength. Another primal necessity, in Mr. Coghlan's view, is a complete and systematic record of boiler and engine room performance, and he advocates that a check should be kept on the work of each fireman by the use of a CO_2 recorder on each group of furnaces controlled by him, by the frequent use of an Orsat apparatus and by analysis of ash at each cleaning. Mr. Coghlan contends that these tests are as important as, if not more important than, the use of an indicator on the engines; for the absence of smoke from the chimneys does not prove efficient firing, because there may be a great excess of air in the flue gases. The temperature of the feed water must be watched carefully, as every increase in it means fuel economy. Insulation of the piping and thorough exclusion of leaks in the furnace and boiler setting are highly important. All condensation from the steam system should be returned to the boilers. Periodic inspection of the entire plant equipment is imperative, some parts requiring examination daily.

Electric Vehicles.

At the same gathering a valuable paper was read by Mr. W. A. Manwaring on the operation of electric vehicles. Summarising the advantages of the electric over the horse-drawn vehicle, he said it covers more distance and travels faster; requires less stable room and less space on the street; can be stored in or near the warehouse; reduces insurance; can be worked for longer hours and on every day; does not litter or damage the street; requires less delivery units and does more work in less time; can be equipped with a motor to pull cable, erect poles, hoist safes, etc.; is modern and a good advertisement. There is also the central-station point of view to be considered. For instance, a one-ton car requires about 19 kw.h. per charge and a five-ton car about 47 kw.h., or from 5,700 to 14,100 kw.h. per vehicle per annum. Mr. Manwaring gave a series of performance data with electric vehicles. Eleven one-ton cars averaged 1·21 kw.h. per mile on 409 miles covered per month for a period of two years. Two three-ton cars averaged 2·14 kw.h. on 207 miles per month; two other three-ton cars averaged 1·94 kw.h.; a 1,000-lb. car averaged 0·715 kw.h. on 602 miles per month for 18 months. And this was prior to the recent marked improvements in storage batteries.

The Ratio of Transformation.

In view of the fact that the ratio of transformation of a transformer is an expression which may be used in several different senses, and that there is at present no uniformity in the meaning given to the expression by different engineers and writers of text books, the Chicago "Electrical Review" urges that the committees on terminology should give some attention to this subject. To conform to reason and general usage, the ratio of a potential transformer should be defined as the ratio of the effective voltage at the primary terminals to the effective voltage at the secondary terminals, and the ratio of a series transformer as the ratio of primary current to secondary current. In support of this proposal it is pointed out that when a transformer is to be used in making accurate measurements, as in stepping down from high voltages or currents to the range of ordinary instruments, it is necessary to know the exact ratio of the terminal pressures, or of the currents. Owing to internal resistance and to magnetic leakage, the ratio of terminal voltages in a potential transformer is never quite the same as the ratio of turns. Consequently, at least in instrument transformers, it is customary for the manufacturer slightly to alter one of the windings so that the nominal ratio is not the ratio of turns. The latter is not indicated on the nameplate, and is generally unknown to the user. The nameplate should, and usually does, indicate the ratio of terminal voltages, or of currents, or some particular load, for this is the ratio of interest to the user. This ratio depends upon the load, frequency, and other conditions of use, and is, consequently, a variable factor. It has a definite value only under definite conditions. When a numerical value is given to a transformation ratio, this value should in itself indicate the direction of transformation. Thus a ratio of "ten" should be understood to mean a step-down transformation, and "one-tenth" a step-up transformation.

A Submerged Motor.

A remarkable illustration of what can be accomplished by trustworthy apparatus is given in the "Southern Electrician." The apparatus in question was a 20 h.p. three-phase 220-volt standard induction motor made by the General Electric Company, and geared to a mine pump at the bottom of the shaft at the mines of the Richmond Iron Works in Massachusetts. The surface water broke in on one of the upper levels and flooded the mine, the water rising so rapidly that the electric pump was soon under water. Though there were two feet of water over the motor, it continued to operate perfectly, and gradually pumped itself clear. Not only did the motor sustain no injury under these exceptional conditions, but it has been running uninterruptedly for 20 hours a day ever since.

Current Items.

A journey of 1,643 miles by electric railway cars is described in the annual issue of the "Electric Railway Journal" by Mr. E. C. Van Valkenburgh. The trip extended from Chicago to New York, with a few side excursions to places of interest. Mr. Van Valkenburgh says that all along the way the roads generally show a high standard of equipment and maintenance both in roadway and rolling stock, and a very satisfactory rate of speed is maintained. On the few short stretches where roadways are crooked and speeds slow, the improvements found or actually under way will make better speeds and service possible within a very short time.

The electric welding process for cast steel devised by the Philadelphia Rapid Transit Company has now, it is announced, been in use for upwards of a year-and-a-half with conspicuous success. By means of a water rheostat, the ordinary trolley potential is reduced to about 20 volts. The arc can be easily manipulated for a great variety of welding purposes, such as relining or filling worn holes, thickening the worn ends of brake beams, building up armature shafts and repairing truck frames without disassembling, etc. The welding flux is a secret composition discovered by Harry Branson, superintendent of rolling stock and equipment. The arc has also been found equally convenient for cutting metal. Owing to its intense whiteness, each operator is provided with a metal hood, with a coloured lens.

Mr. A. C. Hunt has patented a device for use as a safety appliance at crossings of highway and trolley lines. It consists of a large disc suspended like a pendulum from a steel support, on the top of which is installed a regular trolley car bell. The disc bears the words "Look Out," while at night two white lights at the top of the pole serve to light the crossing and a red light illuminates the centre of the disc. Two rails, 1,500 ft. each way along the track, are arranged so that the wheels of the approaching cars form an electric contact causing a small motor to swing the disc backwards and forwards.

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Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

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Municipal Central-Station Engineers and Tramway Managers are invited to send advance notes of new work being undertaken by them, and of successful results obtained from the undertakings under their charge.

Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

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STEEL AND ELECTRICITY.

Sheffield believes in herself and in her institutions in so whole-hearted a way, that we have all come to recognise the installation of the Master Cutler as one of *the* events of the year. For the Master Cutler symbolises the industrial life of the city. Luckily, however, Sheffielders are too hard-headed to regard their Master Cutler with any undue reverence, and so the peevish, self-satisfied remarks of Alderman Senior at his installation last week are not likely to do much harm. He thanked heaven that Sheffield had learnt how to make tool steel before chemistry was known, damned the meetings of learned societies with petulant condemnation, and roundly declared that people went to the Iron and Steel Institute meetings simply for advertisement. He was particularly scathing as regards the readers of the two papers at that (the Buxton) gathering who dealt with questions of electrical practice, and scoffed at the electric furnace. To him, Siemens, Martin and Bessemer were annoying, childish interlopers. He regarded with the utmost distrust pure metal, did not believe in refining, and pinned his undying faith to crucible steel. He had seen experiments carried out in 1879 at Millwall by Dr. Siemens with the electric furnace. But he had had his doubts then, and ever since electrically made steel had been made and experimented with at Sheffield with the saddest of results, and so on, and so on. Luckily, we say, Sheffielders who laugh at their Master Cutler's humour of magisterial ponderosity, are not likely to take him too seriously in his mood of carping criticism of scientific progress. Even the process known as crucible casting was not perfected in a day. And certainly the Siemens electric furnace of 1879 is not the furnace of to-day, nor is that of to-day precisely

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what we may expect when a few "to-morrows" have come, heaping up experience and the labours of earnest workers which will help to bring the new furnace nearer to perfection. Enthusiasts, no doubt, are apt to claim overmuch, for they are the people gifted with insight, who see ahead and by their faith and hard work bring about real improvements. Critics standing outside the circle of ardent workers may see that the electric furnace in its various phases is still open to improvement, and does not supplant older methods for special classes of iron and steel. But in the main it does represent an advance, both as regards economy of working and the excellence of products. In a world such as ours we must bear with many Alderman Seniors, though we must take care that we refine their phrases in the ardent furnace of common sense. But, as we have said, Sheffield is sound enough, though she may be slow. Some half-a-dozen or more of the big iron and steel people there are taking up electric furnace practice seriously, and others are following suit. Were it not so, we might begin to despair of Sheffield. For these wide-awake ones will find electrically smelted pig-iron and electrically melted steel as epoch making as Siemens, Martin and Bessemer steel have proved.

LONDON CABLE LAYING.

The London County Council have approved the laying of electric cables by the following companies:—The Brompton and Kensington Electricity Supply, in the Boltons and Harrington-gardens; the County of London Electric Supply, in Bedford-avenue, Marlborough-road, Lyndhurst-road, Strathbrook-road, Kingscourt-road, and Queen's-road, Battersea; the Metropolitan Electric Supply, in Bark-place; the Notting-hill Electric Lighting, in St. Mark's-place; the St. James's and Pall Mall Electric Light and Power, in Mason's-yard, Duke-street, King-street, St. James's-square, George-square, and Pall Mall; the South Metropolitan Electric Light and Power, in Upwood-road, Reading-lane, The Avenue, Greenwich, Charlton-road, and Beaconsfield-road and High-street, Lewisham. All the above are low tension mains. The South Metropolitan Electric Light and Supply will also lay high and low tension mains in Brownhill-road, Lewisham; the Charing Cross, West-End and City Electricity Supply, in the Kingsway-subway; and the Metropolitan Borough of St. Pancras, in Mabledon-place, Bidborough-street, Howland-mews-east, Dickenson-street, Drummond-street, Dalby-street, Tottenham-street, Drummond-crescent, Guildford-street, Reeds and Rochester-place. The South Metropolitan Electric Light and Power will erect street transformer boxes in High-street, Lewisham, and Loampit-vale. Notices have also been served of the undermentioned cable-laying, but over which the County Council has no authority:—Battersea Borough Council: Bramfield-road, Spencer-road, Lavender-hill; Bermondsey Borough Council: Market-street; Hackney Borough Council: Victoria-park, Gore-road, Springfield-street; Hampstead Borough: Chislett-road, Cleeve-road, Woodchurch-road, Priory-road, Belsize-park, Belsize-park-gardens, Belsize-square, Lancaster-place, Lambolle-road-place, Well-road, East Heath-road, Well-walk, Gainsborough-gardens, Willow-road, Heath-side, Broadhurst-gardens, Compagne-gardens, Canfield-gardens, Greencroft-gardens, Fairhazel-gardens; Islington Borough Council: Ashbrook-road, Hercules-road, Grafton-road, Calabria-road, Corsica-street, and Elthorne-road; Shoreditch Borough Council: To erect feeder pillars in Worship-street and Great Eastern-street, to lay mains in Appold-street, Poole-street, Wenlock-street and Evelyn-street; South London Electric Supply Corporation, Ltd.: Camberwell New-road; Stepney Borough Council: Bedford-street, Morgan-street, Salmon-lane, Carr-street, Artillery-lane and Artillery-passage; Stoke Newington Borough Council: Wilberforce-road; and Woolwich Borough Council: Wellington-road, Anglesea-road, Mount Pleasant-road, and The Slade, Plumstead-common.

THE ANGLO-ARGENTINE TRAMWAYS.

A further considerable step in the extension of the Anglo-Argentine Electric Tramway system has been taken, and the "Buenos Ayres Herald" gives some particulars as to the present state of affairs. It appears that the final plans of the underground tram-line from Plaza Once de Setiembre to Plaza Mayo have been sent in to the Municipal Intendente by the Company. According to the details obtained, the tunnel will be much nearer the surface than is usually the case; in fact, the maximum depth at any point is to be only 7 metres, whereas in Paris it is 12 or 13 metres, and in London 30 to 35 metres below the surface. The line is to be a double one, and stations will be situated at eight points. The mean velocity at which the cars are to run will be 18 kiloms. per hour, so that the distance between Plaza Mayo and Once can be covered in not more than 12 minutes. The cars are not to be of a uniform type. Some of them will be of a convenient type for running either on the underground line or on the surface lines. At the Once terminus these coaches, which will be capable of conveying 60 passengers, will run up a gradient to the surface and continue the journey to Villa Devoto, or *viâ* Calle Rivadavia to the Municipal boundary.

In the event of two trams, one from the Rivadavia line and the other from Devoto, arriving simultaneously at the Once end of the tunnel, they will be connected by an automatic coupling gear, and will continue the journey thus to Plaza Mayo. The whole convoy will then be under the control of one motorman.

The tunnel is to be a solid structure of brick and cement with arched roof. At each of the stopping places mentioned there is to be a station with a wide platform, long enough to accommodate a convoy of eight coaches. Access to the stations will be provided for by two flights of steps leading to a landing stage where the booking offices will be situated, and thence to the platform. Egress from the stations will be by a separate way, to avoid crowding and confusion.

The rails are to be of unusual weight in order to reduce vibration to a minimum. They are to be laid on hardwood sleepers superimposed upon an extra thick layer of ballast, so as to obtain the maximum of elasticity with the minimum of noise.

The electric cables will be enclosed in piping of uninflammable material. The power supplied for working the signals and for giving light will be independent of those providing motive force, so that in the event of the latter current failing, the lighting and signalling service will not be affected. For this purpose accumulator batteries will be installed capable of affording the necessary power for working the signals and affording light for a period of 48 hours.

In order to admit of passengers entering or leaving the tramcars rapidly, egress and ingress will be by the sides. Opening and closing them will be effected by the motorman, by means of a current of compressed air, which will keep the doors closed while the train is in motion. Every coach will be provided with an air-brake, life-saving apparatus, and automatic coupling gear.

Provided the Municipality approved of the plans and specifications, it was proposed to start preliminaries on October 6th, although the real work will probably not commence before next January. The tunnel should be completed and the metals laid before the end of 1911.

RENOLD CHAINS AT BRUSSELS.

It is certainly exceptional for a firm exhibiting for the first time at an International Exhibition to obtain a Grand Prix, but Messrs. Hans Renold, Ltd., have achieved this distinction, and, in addition, have been awarded two Diplomas of Honour.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

DERBY.—All formalities in connection with the Derby Electric Lighting (Extension) Act having been observed, the developments provided for under the Provisional Order will shortly be carried into effect.

GLOUCESTER.—The Town Council have adopted the following variations in the flat rate:—Existing rate of 4d. per unit to apply up to 500 units each quarter; the next 1,000 units to be at 3d., and all above this quantity at 2½d. On the suggestion of the Engineer, it was decided to accept the offer of Messrs. Bennis to supply and fix one of their automatic stokers to No. 7 boiler for the sum of £143, the purchase to be subject to two months' trial proving satisfactory.

IPSWICH.—The Corporation have decided to apply to the Local Government Board for powers to borrow £17,000 for purposes of their electricity undertaking. Of this sum £6,007 has already been expended. The balance is required to meet the cost of extensions during the next few years, as follows:—For mains extensions, £5,893 6s. 10d.; for services, £1,559 12s. 1d.; for meters, £1,492 5s. 3d.; for expenditure on rental wiring, and motors and arc lamps, etc., for hiring, £2,047 12s. 4d.; total, £10,992 16s. 6d. The Board is almost sure to raise objections to the amounts set aside for services and meters, as the policy now is that these items should be provided out of revenue, especially when an undertaking is, like that of Ipswich, rather more than paying its way.

KINGSTON-ON-THAMES.—In view of there being an increase of a halfpenny in the lighting rate, and the fact that the Electricity Committee estimate for a loss of £1,100 on the year, a strong expression is given that the price of current to private consumers should be raised.

LONDON: STEPNEY.—It has been decided by the Borough Council to borrow £7,150, the cost of additional plant required at the electricity station.

LYNMOUTH.—New plant is being installed at the electricity works under the supervision of Mr. P. T. Kimmins, the manager.

MIDDLESBROUGH.—It has been decided that the Borough Electrical Engineer is to advise the Education Committee on the electric lighting of the schools. The boilers at the works have been reset at a cost of £550. It appears that the audited accounts for the past year show a profit of nearly 7¾ per cent. on the rather heavy capital outlay.

MOTHERWELL.—Building work on the municipal electricity works extension is to be put in hand at once.

NEW ROSS.—Messrs. Wilkins & Burden, electrical engineers, of 13, Belvedere-place, Dublin, have written to the Town Council saying that they proposed to promote the New Ross Eletcricity Supply Company, Ltd., which would expend about £4,500 and generate electricity for sale at 6d. per unit, and asking whether the Council would be likely to support the scheme. It was decided not to express any official opinion. The promoters expect to face an annual expenditure of £383, to have an income of £907, out of which they would assign £112 for depreciation, pay 8 per cent., or £360, and have £252 to place to reserve.

PONTYPRIDD.—The report of the Corporation Electricity Works for the year ending March 31, just issued, shows that the total increase was £8,804 (as compared with £9,039 in 1909), and the expenditure £4,998 (£5,670 in 1909); the gross profit was £3,805 as compared with £3,369. This is evidence of most careful management, for the increased profit on a falling revenue is most substantial.

RHYL.—As the result of Mr. E. H. Wright's plans for the more economical working of the Corporation Electricity Works new plant has been laid down. This consists of a 4-cylinder "Mirrlees-Diesel" oil engine capable of developing 180 b.h.p. at 230 r.p.m., directly coupled to a 125 kw. continuous current dynamo, manufactured by the Electric Construction Company, of Wolverhampton. The engines were manufactured by Messrs. Mirrlees, Bickerton & Day, Ltd., at their works at Hazel Grove, near Stockport, and are of their standard design. In order to inaugurate the additional a formal visit of inspection, followed by a luncheon, was held, when Mr. Wright, the electrical engineer, was congratulated on the improved aspect of affairs.

WELLINGTON.—The Town Council have decided not to oppose Messrs. J. and D. Purves, of Exeter, applying for a Provisional Order under the Electric Lighting Acts, but to see that clauses favourable to the town were inserted.

WEST HAM.—The Guardians have invited tenders for the installation of electric light at the Receiving Homes now in course of erection at Aldersbrook-road, Wanstead.

WHITCHURCH.—A proposal was before the Urban Council for the adoption of the Electric Lighting Act, but the following amendment was adopted: "That while this Council is not prepared to undertake of itself the provision of electric light in the town, it is prepared to give favourable consideration to any application for powers by any responsible company for that purpose."

OVERSEAS.

CALCUTTA.—It is reported that the Great Indian Peninsula Railway Company are arranging for the provision of an electric power house, together with generating plant sufficient for the requirements of the carriage and wagon department until the new carriage and wagon workshops at Matunga are ready, when the Parel workshops will be used for locomotive work only.

HOBART, TASMANIA.—The Complex Ores, Ltd., have taken up 2,000 acres of land at North West Bay, where they will erect metal refining works, carbide and chemical manure factories. A large hydro-electric installation is to be set up for these various works, the water being derived from the Great Lake.

INVERELL, NEW SOUTH WALES.—The municipality have invited tenders for the supply, delivery and erection of a complete electrical plant. Tenders are to be delivered by November 14. Mr. J. E. Donoghue, is the municipal engineer.

NEW WESTMINSTER, B.C.—The British Columbia Electric Railway, from New Westminster to Chilliwack on the south side of the Fraser River, has now over 80 miles of track open for traffic.

RIO DE JANEIRO.—The Campanhia Brazileira de Energia Electrica, who have their head office at Rio de Janeiro, have just obtained from the Mayor of the Federal District the approval of the plans and schemes for the laying down of the Underground Canalisation about the City of Rio, according to contracts celebrated on April 25, 1909, with the mayoralty of the city, which has just been published in the "Times" of August 12.

YORKTON, SASKATCHEWAN.—The municipality are now considering tenders for the erection of an electric lighting plant.

TRACTION.

HOME.

BIRKENHEAD.—A joint conference of delegates of the Town Council and the Wallasey Council is to take place to arrange details regarding the running of Corporation tramcars over the Penny Bridge.

HALIFAX.—A proposal that an engineer be appointed with direct responsibility to the Tramways Committee, to have sole control of the construction and maintenance of the permanent way, was negatived in the Town Council.

LONDON: WOOLWICH.—A local committee, which has been formed of representatives of working men's clubs and associations, demands of the London County Council (1) that Beresford-square be created a tramway centre, that all cars running into the centre shall carry workmen at the rate of 1d. return for the full journey up to 9 a.m., then from 12 noon to 2 p.m., and that return tickets may be used for any car; (2) that all children under 12 be carried at half-price, and (3) that all children attending the higher-grade schools be carried free to and from school.

PARTICK.—A suggestion is made that if Partick and Govan agree to absorption by Glasgow a new subway under the Clyde—large enough to accommodate vehicular and foot traffic and tramway—should be constructed.

SCARBOROUGH.—The Tramway Company having notified their intention to discontinue running trams during the winter months, the Town Council are appealing to the Board of Trade.

OVERSEAS.

DEVONPORT, TASMANIA.—The municipality is about to apply for authority under the Local Government Act to lay down a 2 ft. tramway from Devonport via Barrington to Wilmot, a distance of approximately 28 miles. The line would serve a large agricultural district, and also help to open up the silver-lead, coal and shale mines which are now attracting attention. Mr. Geo. H. Lofts, A.M.I.E.E., is preparing a report on the practicability of operating the line electrically. Water power is available on the route for nine months of the year, but for the remainder of the time it would be necessary to supply current from the existing steam plant at Devonport. In addition to the freight on goods which would provide a fair revenue, there would be a certain amount of through passenger traffic, whilst it is thought that the section within eight miles from Devonport would warrant a more frequent service for passengers.

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RIO DE JANEIRO ELECTRIC WORKS.

The Companhia Brazileira de Energia Electrica, who have their head office at Rio de Janeiro, announce that they have just obtained from the Mayor of the Federal district the approval of the plans and schemes for the laying down of the underground canalisation about the city of Rio, according to contract celebrated on April 25, 1909, with the Mayoralty of the city, which was published on August 12. "Much has been published," the company says, "with regard to this privilege, and in connection with others concerning the Rio de Janeiro Tramway, Light and Power Company, and for the sake of our rights and a clear understanding of this matter we wish to say that these acts of the Mayor of the Federal district—the contract of April 25 and of the present approval of the plans and schemes of the underground canalisation with the Companhia Brazileira de Energia Electrica—are in every respect legal, and have not been denied by any court. The privilege of the Rio de Janeiro Light and Power Company is for the supply of electric energy, generated by hydraulic means only, until June and September of 1915, for energy and private light respectively. The Companhia Brazileira de Energia Electrica propose to supply such energy generated by any other way except by hydraulic means at once, and the private lighting from September, 1915, on, as at this date the Light and Power privilege expires. This is entirely according to the law provisions."

CITY ELECTRIC LIGHT.

The directors' report for the half-year ended July 31 1910, states that during the half-year the revenue from the sale of electricity has increased, as compared with the revenue for the corresponding period of 1909, 29%, while revenue from all sources has increased 28%. The results of the half-year's working have been such that the usual sums have been placed to the credit of the franchise purchase sinking fund and the accident insurance account, and substantial sums to the credit of the renewals, replacements and contingencies account. The directors have considered it advisable to establish a reserve fund and also a dividend equalisation fund; after making these provisions there remains a credit balance of £4,381 2s. 5d., which, with the balance brought forward from last half-year, makes a sum of £6,384 3s. 11d. to be disposed of. They recommended that a dividend be paid at the rate of 6% per annum on the preference shares and at the rate of 10% per annum on the fully-paid ordinary shares, and at the rate of 10% per annum on the contributing shares in proportion to the amount paid up thereon. They also recommended the payment on the same date of a bonus at the rate of 2% per annum on the fully-paid ordinary shares and at the rate of 2% per annum on the contributing shares in proportion to the amount paid up thereon. The payment of the above-mentioned dividends and bonus, together with the dividend duty, will absorb £4,548 18s. 7d., leaving a balance of £1,835 5s. 4d. to be carried forward. The building of the new water-side Power Station in William-street is nearly completed, and progress has been made with the foundation for the 700 kw. turbo generator, and the erection of the new boilers. The demand for electricity is such that, after careful consideration, it has been decided to materially increase the capacity of the new station. To this end, a second boiler and another turbo generator of 500 kw. capacity, together with the necessary condenser, pumps and economiser, as also a large quantity of underground mains, have been ordered.

FINANCIAL NOTES.

COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, LTD.—There was an issue on September 15, 1910, of £3,875 4½% First Debenture stock, part of a series of which particulars have already been filed.

* * *

CALCUTTA ELECTRIC SUPPLY CORPORATION.—The directors have declared an interim dividend on the Ordinary shares for the half-year ended June 30 last, at the rate of 7% per annum, such dividend to be payable on November 15 next.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 142, Fleet Street, London, E.C.

CONTRACTS.

COUNTY BOROUGH OF WEST HAM.

TO ELECTRICAL CONTRACTORS, TRAM-CAR BUILDERS, AND OTHERS.

The Council hereby invite TENDERS for 12 DOUBLE-DECK ELECTRIC TRAM-CARS, 12 MAXIMUM TRACTION TRUCKS, and 12 COMPLETE ELECTRICAL EQUIPMENTS, including MAGNETIC TRACK BRAKES.

Specification, From of Tender, and further particulars may be obtained from Mr. H. E. Blain, Tramways Manager, Greengate-street, Plaistow, E., on and after Monday, October 10, 1910, on the deposit of a £5 Bank of England Note, which will be returned on receipt of a bona fide Tender.

Tenders endorsed "Tender for Tramcars," to be delivered by registered post to my office not later than 10 o'clock a.m. on Thursday, October 20, 1910.

The Council does not bind itself to accept the lowest or any Tender.

The Contractor will be required to enter into a bond with two sureties for the due performance of the Contract, and no work will be ordered under the Contract until such bond has been duly executed.

The Contractor whose Tender is accepted, and with whom a Contract is entered into, will be required to pay all workmen employed by him in or about the Contract such rates of pay, and observe such hours of labour as are embodied in the schedule, which will be part of the Contract. In the event of any breach of such agreement, the Council will enforce the penalty clause in its entirety.

A Tender will not be accepted unless it is stated by the Contractor in the Tender, and proved to the satisfaction of the Council, that the Contractor, at the date of the Tender, pays to the whole of his workmen such rates of wages, and observe such hours of labour as are recognised by the Workmen's Trade Unions in the several localities where his work is done. If, after the Contract is signed, it shall be proved that the said statements of the Contractor in the Tender are contrary to fact, the Council shall be entitled to rescind the Contract or at its option to recover from the Contractor as liquidated damages, and not as a penalty, the sum of £50.

By order of the Council,

FRED. E. HILLEARY,
Town Clerk.

Town-hall, Stratford, E.,
October 3, 1910.

THE DUBLIN UNITED TRAMWAYS CO. (1896), LIMITED.

The Company is prepared to receive TENDERS for the SUPPLY OF GENERAL STORES, including Car Fittings, Iron, Steel, Castings, Oils, Paints, Glass, Brushes, Ironmongery, Harness Materials, Electric Supplies, Timber, etc., for the year ending December 31, 1911.

Forms of Tender (price 2s. each), Conditions, and all information can be obtained and patterns seen at the Secretary's Office, 9, Upper Sackville-street, from October 17 to October 31, 1910.

Tenders, sealed and marked on the outside, "Tenders for Stores," and addressed to the Chairman, Dublin United Tramways Company, must be lodged with me on or before November 7, 1910.

By Order,

R. S. TRESILIAN,
Secretary.

9, Upper Sackville-street,
Dublin,
October 12, 1910.

APPOINTMENTS.

LITTLEBOROUGH URBAN DISTRICT COUNCIL.

ELECTRICITY SUPPLY.

APPOINTMENT OF CLERK OF WORKS.

The Urban District Council of Littleborough are prepared to receive applications from competent men prepared to act as Clerk of Works, under direction of their Consulting Engineers, during the laying of H.T. and L.T. Electric Cables and Installation of H.T. Switchgear.

Applicants must be thoroughly conversant with work of this character.

Salary three guineas per week.

Applications, giving full particulars of past experience, accompanied by copies of not more than three recent testimonials, and endorsed "Clerk of Works, Electricity Supply," to be sent to the undersigned not later than Monday, October 17, 1910.

Personal canvassing will disqualify.

(Signed) GEORGE H. WILD, Clerk to the Council.

Council Offices, Littleborough, near Manchester.

CONTRACTS OPEN.

HOME.

BOURNEMOUTH.—H.M. Office of Works invite tenders for the erection of the Bournemouth Parcel Sorting Office and Telephone Exchange. Particulars from H.M. Office of Works, Storey's-gate, Westminster. October 14.

CHESTER-LE-STREET.—Rural District Council.—Electric light, power, ventilating fans at hospital. (Specification, 10s. 6d., Clerk, Union Offices.) October 19.

FARNWORTH.—Urban District Council.—Electric lighting, ventilating. (Specification, £2, W. J. Lomax, 11, Fold-street, Bolton.) October 19.

GILLINGHAM.—The Electric Light and Power Department invite tenders for a year's supply and delivery of coal. Particulars from the Electrical Engineer. October 17.

HALIFAX.—The Tramways and Electricity Committee invite tenders for the following plant: (1) one 1,500 kw. turbo-alternator complete with condenser; (2) two 750 kw. rotary convertors complete with transformers; (3) switchboard and platform for the above plant. Particulars, (£10) from the Borough Electrical Engineer. October 17.

WEST HAM.—The Council invite tenders for 12 double-deck electric tram-cars, 12 maximum traction trucks, and 12 complete electrical equipments, including magnetic track brakes. Specifications, etc. (£5), from the Tramways Manager, Greengate-street, Plaistow, E. October 20.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage électrique à Béni-Souef—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministère de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

JOHANNESBURG.—H.M. Trade Commissioner for South Africa (Mr. R. Sothern Holland) reports that tenders are invited by the Johannesburg Municipality for the supply and delivery of five electric tramcars. The contractor must provide all the necessary labour, materials, tools and appliances required for erection, and space in the municipal car-sheds will be allotted to him for carrying out the work. Early delivery is important.

OSRAM·LAMPS

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Tenders will be received by the Town Clerk, Municipal Offices, Plein Square, Johannesburg, up to noon on November 4th. The conditions and specification may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

PARIS.—The "Moniteur Officiel du Commerce" (Paris) contains a notice inviting tenders for the supply and laying of a submarine cable between Libreville and Loango (Pointe Noire). To qualify tenders, a provisional deposit of 50,000 francs (£2,000) will be required, to be increased by the successful tenderer to 100,000 francs (£4,000). Tenders will be received up to October 14 at the "Bureau de l'Ingenieur Chef des Etudes, Ministere des Colonies, rue Oudinot No. 27," Paris.

SHANGHAI.—Tenders are invited by the Shanghai Electricity Department for the supply of the following: (1) Electric heating and cooking appliances; (2) 10,700 carbon filament lamps; (3) 15,000 metallic filament lamps. Sealed tenders, marked "Tender for Heating and Cooking Appliances," or as the case may be, should be addressed to the Acting Secretary, Council Rooms, Shanghai. Date: (1) October 10; (2) and (3), October 20.

TENDERS ACCEPTED.

HOME.

BURY.—The following tenders have been accepted by the Corporation:—Boiler feed pumps, Clarke, Chapman & Company, Ltd., Gateshead; water meter (to measure the feed water), Glenfield & Kennedy, Ltd., Kilmarnock; 30-in. valve and strainer box, J. Blakeborough & Sans, Brighouse: water weighting apparatus, W. & T. Avery, Ltd., Birmingham.

LONDON.—The County Council accepted the tender of Messrs. E. Lawrence & Sons, Ltd., Wharf-road, N., for £1,702 for wiring for electric lighting of the Central Car Repair Depot. Of the Standard Engineering Company, Ltd., Leicester, for £539, for the supply, delivery and erection of dust removal plant. Of Messrs. Henry Pooley & Company, Ltd., Fleet-street, for £100 (less 2½% discount), for 8 cast-iron turntables, all for the same depot. Also the tender of Messrs. Johnson & Phillips, Ltd., of £2,185, for covering with asbestos tape of various high and low tension electric tramway cables.

SLEAFORD.—The tender of Messrs. Pattenson & Company for the supply of coal at 14s. 11d. per ton for the next six months was accepted.

NOTES.

Brimsdown Lamps.

In readiness for the lighting season, the Imperial Lamp Works (Brimsdown), Ltd., have brought out a handsome and effective trade showcard, measuring 20 inches by 15 inches, for placing in shops or windows. The company will send copies of these carriage free to any contractor who will apply for them at Kingsway-house, Kingsway, London, W.C. We may again point out that the Brimsdown metallic filament lamps are of British manufacture, and are proving an excellent selling line.

Simplex Conduits, Ltd.

The Simplex Conduits, Ltd., notify that they have removed their meter department from 116, Charing Cross-road to Garrison-lane, Birmingham, where Mr. Wahl, the manager of this department, will in future have his offices. All testing will also be carried out at the works.

Water Turbines.

Messrs. Raithby, Lawrence & Company, Ltd., are bringing out a portly book on "Water Turbines," by Mr. Jens Orten Böving, M.I.Mech.E., senior partner in the firm of Messrs. Jens Orten Böving & Company, of 9½, Union-court, Old Broad-street, E.C. The available sources of information in regard to water power in this country are very limited, and are in most cases the result of translations somewhat clumsily rendered, or they exist merely as treatises in Germany, with which the majority of engineering students have not the time to make themselves familiar. It was in response to the pressing need for such a book, as expressed by consulting engineers in Great Britain, that Mr. Orten Böving decided to publish much of the knowledge that he had acquired in the course of his experience in Continental high schools, the foremost Continental works, and in the course of a five years' practice as a water power specialist in London, and it is interesting to note that the basis of the volume is a series of lectures which Mr. Böving read before the Japanese Association of Mechanical Engineers, and that these letters were eventually privately issued in book form as a part of the Journals of that society; since which time they have become a text-book for all students of water power and its many problems in Japan.

The Sloan Electrical Company.

Owing to the great increase in their business in carbons, cables, insulators, metal filament lamps and electrical accessories generally, Sloan Electrical Company, Ltd., have found it necessary to secure more commodious premises. They will therefore shortly be removing to Conradty-house, 12, Golden-lane, E.C., and the trade will in the course of a few weeks be notified by circular of the exact date of removal.

Shadolite "Tantalum" Advertising.

Reverting to our article on advertising, we would point out to contractors that Messrs. Siemens Brothers Dynamo Works, Limited, Tyssen-street, Dalston, N.E., have in hand a further advertising device, consisting of opal shades on which are sand-blasted the words "Tantalum" Lamps. These opal reflectors will be supplied to contractors free of charge, for use on the lamp holders in their premises. This seems an exceptionally happy device, as it provides the contractor with a neat reflector and at the same time advertises the fact that he sells "Tantalum" Lamps. These things are now known to the trade as Shadolite "Tantalum" reflectors, and Messrs. Siemens Brothers inform us that they will be prepared to send same, free of charge, to any contractors who will instal them on their existing lampholders. These specialities are offered in conjunction with the main advertising scheme mentioned in a previous issue, and should strongly appeal to the consumers. We would recommend contractors to adopt this method of advertising, which is effective and efficient. Shadolite "Tantalum" shades are lettered on the inner surface for interior lighting, but for outside lighting they are supplied lettered on the upper surface. This, it will be observed, will not only attract the attention of the intending buyer, but will appeal to the passer-by, who cannot fail to be aware of the nature of the specialities to be obtained inside.

Electric Organs.

A new organ has been installed in Mill Hill Chapel, Leeds. It was built by Messrs. Norman & Beard, of Norwich, and embodies most of the latest ideas in organ construction. It has three manuals, with a compass over 61 notes, and a pedal organ of 32 notes. The great organ contains nine stops; the swell organ, eleven; the choir organ, seven; and the pedal organ, six. There are 11 couplers and 12 pistons, distributed over the three manuals, and eight combination pedals. Electric action is fitted to the great and choir organs, and wind is supplied by a rotary blower operated by an electric motor.

DIARY.

FRIDAY, OCTOBER 14.

ENGINEERING AND MACHINERY EXHIBITION.—At the City Exhibition Hall, Manchester, opening of the Exhibition. Closing day, November 5.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Section).—Conversazione, at 7.30, at the Whitworth Institute, Whitworth-park, Manchester.

FRIDAY, OCTOBER 21.

INSTITUTION OF MECHANICAL ENGINEERS.—At the Institution, Westminster, at 8 p.m., Mr. Cyril Hitchcock on "The Standardization of Locomotives in India, 1910."

ELECTRICAL ENGINEERS, TERRITORIALS (London Division).—The following are the orders for the week ending the 22nd instant:—"A" Co., Monday, October 17, 1910, Technical Drill, 7 to 10 p.m.; lecture on "Water Testing Apparatus," by Second-Lieut. W. P. Digby, E.E.L.D. "B" Co., Tuesday, October 18, 1910, Technical Drill, 7 to 10 p.m. "C" Co., Thursday, October 20, 1910, Technical Drill, 7 to 10 p.m. "D" Co., Friday, October 21, 1910, Technical Drill, 7 to 10 p.m.

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
HULL.

A FEAT IN WIRELESS TELEGRAPHY.

The Revolution in Portugal has directed attention to wireless telegraphy in connection with its political value in a manner that has hardly been appreciated up to the present.

The message reporting the outbreak of a Revolution was only received by the aid of the Telefunken system of wireless telegraphy; this being the second occasion in which this system has helped to make history. Owing to the fact that the land telegraph lines had been cut by the Republicans, the correspondent boarded the s.s. "Cap Blanco," of the Hamburg South American Line, in the harbour at Lisbon, as this ship is fitted with a Telefunken wireless station, and transmitted the message in the following manner:

The "Cap Blanco" had arrived at Lisbon during the night of October 4 and 5, on its return trip from Buenos Aires. Besides being fitted with the Telefunken apparatus, the latter is worked by officials of the Telefunken Company, who called up the sister s.s "Ypiranga" which was lying at Santander in the Bay of Biscay, and communicated to her the first news of the outbreak of the Revolution. The "Ypiranga" transmitted the news to Paris. In the meantime, however, other correspondents had arrived on the "Cap Blanco," and the operator was asked to forward other messages to Berlin. For this purpose he was required by his instructions to call up the nearest wireless ship or coast station which it was possible for him to reach with his apparatus. Amongst the ships which according to the time-tables at his disposal appeared to be within reach of the ether waves of his apparatus, there were none which would reach any coast within a reasonable time. Hence the operator attempted to communicate with the nearest land stations. These were either Algiers or St. Marie de la Mer, near Marseilles. The route to the former involved greater expense so the operator attempted to call up the St. Marie station about 10 times. This station is equipped with a receiving apparatus for specific wave length. The operator on the "Cap Blanco" therefore gave the call which set the receiving apparatus at St. Marie in operation, whereupon St. Marie returned the call. The operator on the "Cap Blanco" then transmitted his message.

As the waves spread in all directions this message could also have been picked up at Algiers, but as the call signal given by the operator was the one belonging only to St. Marie, the Algiers station, in accordance with the International agreement, could not accept it. The messages were retransmitted from St. Marie in the usual manner.

The performance of the wireless apparatus on the "Cap Blanco" must be characterised as quite exceptional, as the distance to St. Marie is about 850 miles, and the course of the ether waves lies over fairly high mountains. As the range of the apparatus is dependent on the height of the masts of the ship, and the "Cap Blanco" is not fitted with specially high masts, the performance of the Telefunken apparatus is all the more noteworthy. As a matter of fact, the oscillating energy of the apparatus is 1·5 kw. and the masts are 32 and 41 metres high.

It is of interest to note that the Telefunken system is being developed by Messrs. Siemens Brothers & Company, Ltd., at their Woolwich Works.

BUENOS AIRES ELECTRICITY.

According to the "Review of the River Plate," a number of capitalists in Buenos Aires are taking steps to form a limited liability company on the co-operative system for the purpose of generating and supplying electric light and power. The majority of the initiators of the scheme are French and English business men residing in the country. Engineer Eduardo Volpati has been designated to approach the municipal authorities in the matter and lay before them the details of the scheme, which are as follow: The concession for the production, distribution and sale of electric energy is to be for a period of 40 years, at the termination of which the whole of the plant, buildings and land upon which the same are situated shall become the property of the municipality without any remuneration and in good condition. All additions and extensions effected by the concessionary company shall also be delivered to the municipality in good condition at the expiration of the concession, the municipality paying for them at cost price less 2½% for each year since their construction. Should the municipality not wish to take over the installations at the termination of the concession upon the conditions stated, notice shall be given to that effect five years before such termination, when an equitable agreement shall be formed regarding the capital invested and the amount of amortization fixed, after which all the installations, additions and extensions shall pass into the hands of the municipality without any compensation. All plant and details shall be submitted to the municipality for inspection. Approval to be given within 90 days, subject to concessionaire providing any information and making any modification required. The maximum prices per kilowatt hour, or any variations or reductions therein, together with the conditions for the distribution and sale of power shall be the same as those established by the German Transatlantic Company. If during the currency of the contract the concessionaire shall with the consent of the municipality adopt an invention or a new system of electrical energy which shall permit of the reduction in an effectual and indisputable manner of over 20% of the cost, the scale of charges at that time in force for the services of the afore-mentioned contract of the German Transatlantic Company shall undergo a reduction equivalent to half the saving effected. In order to estimate the amount of this reduction, provision will be made for the assignation of 7½% annual interest and the corresponding amortization on the supplementary capital employed for the application of the new invention or system.

We do not know what the capital of the new company is to be, but it will be exceedingly venturesome to commence a competition against the existing company, which has its mains extending in every direction, as also seven power-houses.

ELECTRIC LIGHTING FURTHER POWERS BILL.

Stretford has promised financial support; Handsworth and Clacton-on-Sea, moral support; while Crewe will take no action as regards the Bill that is to be promoted by the Incorporated Municipal Electrical Association.

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SPINNING CAN WORKS

for the manufacture of Steel and Fibre Card Cans for Spinning Cotton Wool, Flax, Silk, Jute, and Hemp.

LARGEST MAKERS IN THE WORLD OF SPINNING CANS.

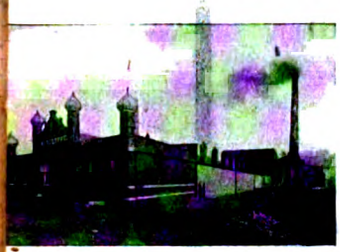
Output - 1,200 Cans per day.

MAKERS OF

VULCANISED FIBRE SHEETS, RODS AND TUBES

for Electrical and Mechanical purposes, Trunks, Boxes, etc.; also Slabs and Blocks for Noiseless Wheels. All qualities, Soft or Hard. Capacity, 45 Tons per Week.

CRUMPSALL FIBRE ROLLING MILLS.



SOUTH SIDE OF WORKS.

WEST SIDE OF WORKS.

NORTH SIDE OF WORKS.

SOUTH-WEST SIDE OF WORKS

J. A. SUTCLIFFE, Managing Director.

GENERAL OFFICES.

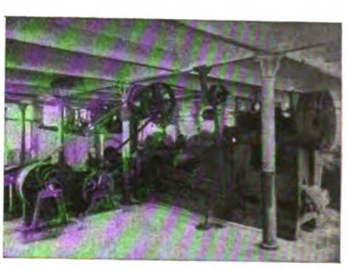
FIBRE SHEET ROLLING MILLS.

FIBRE TUBE ROLLING MILLS.

REEL END CALENDAR.

FIBRE PULP MACHINE.

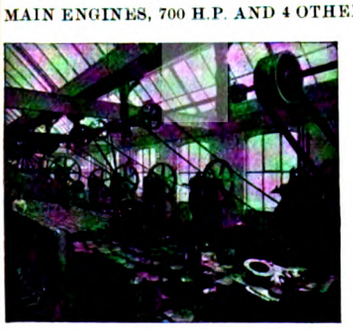
BOILING, WASHING AND BEATING FIBRE.



CHOPPING AND WILLOWING FIBRE

MAIN ENGINES, 700 H.P. AND 4 OTHER ENGINES OF 100 H.P. EACH.

STEAM BOILERS 30 in. BY 8 ft. 6 in. DIAMETER.



CAN PRESS SHOP FOR DRAWING UP SEAMLESS STEEL BINDERS. THE FINEST PRESSING PLANT IN THE WORLD.

MAKING UP AND FINISHING 1,200 CANS PER DAY.

CAN RING SHOP, MAKING 2,400 STEEL RINGS DAILY.

VULCANISED SHEETS SUPPLIED TO SHIPPERS, MERCHANTS, CAN MAKERS, &c.

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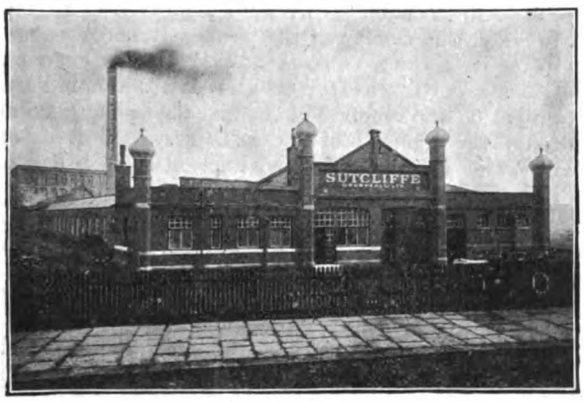
THE MANUFACTURE OF FIBRE.

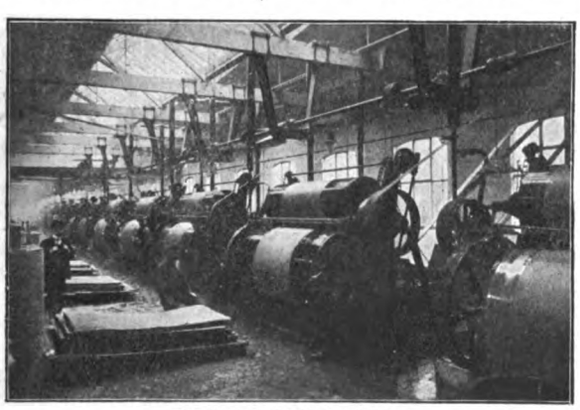
Probably everyone with any practical manufacturing experience at all, has at some time or other been forced to realise that there are some classes of material for which this country depends for its supplies, on other nations. Formerly, this was particularly the case with vulcanised fibre. Who cannot remember some urgent order hung up in the shops, while diligent enquiries were being made of English agents, and costly cablegrams sent to America, all to get a little piece of special fibre—itself worth only a few pence? But this state of things exists no longer as regards fibre, for thanks to the high degree of enterprise which has always characterised Messrs. Sutcliffe (of Crumpsall), Ltd., a large English works, covering four



VIEW OF WORKS.

acres and equipped with even later and more perfect machinery than the best American mills, is now busily turning out at Manchester over 45 tons of the material weekly for electrical and mechanical purposes. (It is pleasing to learn that this enterprise is being so fully rewarded that extensions are under consideration to meet the rapidly growing demands.) This factory is the only one of its kind in Europe, and many of its processes are entirely novel, producing material which not merely compares with that of the old-established foreign factories, but entirely surpasses it in quality.

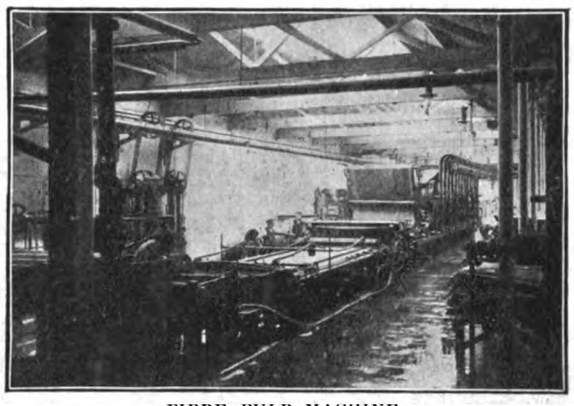
The advantages of having a source of supply of any material in this country must be apparent to everyone. In the first place, the cost of carriage and packing for transit over thousands of miles is saved, as is also the large selling expenses of marketing goods at a great distance from their place of manufacture. Again, instead of having only a few stock sizes—foreign standards at that—practically any requirements can be met by the home factory. (This has proved the case with the new fibre works; special material



FIBRE ROLLING MILL.

can be made up in almost as many days as formerly weeks or months were required). While as to price, it is obvious that a more up-to-date plant on the spot must produce cheaper, and therefore, under even equal conditions be able to sell at lower rates than can an older plant several thousands of miles away. Under enterprising management, therefore, the future of any firm who sets out with new plant to meet a great demand, hitherto supplied solely by foreigners, is assured; Messrs. Sutcliffe's experience proves this conclusively.

The processes through which the fibre passes in the various stages of its manufacture are all very interesting, and involve the use of very powerful and much special machinery. The raw material consists of vegetable tissue in various forms. This undergoes special treatment, and is chopped up and cleaned, being afterwards thoroughly boiled, during which latter process it is mechanically



FIBRE PULP MACHINE.

agitated. This loosens any dirt, which is then washed out in the next process, the vegetable tissue being then beaten into a pulp. It is at this stage that the material is dyed the familiar red, black and other colours.

The dyed pulp is next passed through a paper-making machine (some idea of the size of which is given by the illustration of the pulp end of one of the Crumpsall machines). In this way the pulp is gradually dried by passage over steam heated rollers, and comes out at the other end as finished paper, which is automatically rolled upon huge reels.

This paper is the real starting point in the actual making of the vulcanised fibre, sheets of it being pressed together to make up the required thickness, under hydraulic presses, producing several hundred tons per square inch pressure. The pressed paper is next taken through special vulcanising plant, after which it is thoroughly aged and conditioned

FIBRE BEATING AND WASHING.

and finally dried off. In this stage the surface is slightly rough and the great sheets are not perfectly flat; passages through a pressing machine corrects this and turns out the material in its commercial form, sheared to stock sizes. These sheets are worked into tubes by special machinery, or rolled down in the mills to exact thicknesses.

By variations in the processes, the finished article can be had possessing the density of a metal and the hardness of ivory, yet with considerable elasticity and surprising lightness; or it can be obtained in a very flexible state, having the softness of leather (as a substitute for which it is much used), but with much greater strength and uniformity of thickness and quality.

Hard fibre possesses remarkable tensile strength (8,000–12,000 lbs. per square inch), while, as might be expected from the tremendous pressures to which it is subjected during manufacture, its resistance to crushing is enormous. Its lightness may be gauged from the fact that one square foot of $\frac{1}{4}$-in. thickness, weighs only some 26 ozs. Its very high insulating properties, its insolubility in any of the ordinary solvents, the fact of its being quite unaffected by oils of any kind, have all made its use indispensable in the manufacture of electrical machinery and apparatus of all kinds. The perfect homogenity of its structure enables it to be cut, punched into shapes, filed, sawn, drilled and tapped, or otherwise worked up, while it easily takes a very fine polish.

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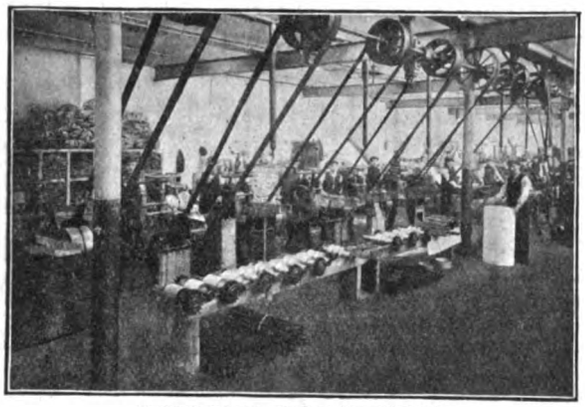
In mechanical manufacturing, its applications instead of a metal is rapidly being extended, and engine valves, journal and thrust bearings, noiseless gear wheels, rollers, press-plates, hydraulic packings, etc., are only a few of the many uses to which it has already been applied with the greatest success.

For tramway and railway work it is extensively used for insulations, axle-box-covers, washers, brake-blocks, controller parts, and in many other places.



FIBRE TUBE ROLLING MILLS.

With the new source of supply in this country and an exceptionally enterprising English firm ready to meet any and every possible use to which this material can be applied, it is more than probable that the near future will see even the present varied uses of fibre very greatly extended. It is idle to wish Messrs. Sutcliffe success in their enterprise, for their business commands it—and gets it. Prompt deliveries, fair prices and eagerness to meet every requirement are their distinguishing characteristics, and these have never failed to achieve success. Their stand will be one of the chief centres of interest at the Machinery Exhibition in Manchester.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

QUESTIONS.

Question No. 1230.—In designing starting resistance for three-phase induction motors, the rotor volts at starting and rotor current per phase are usually given by the makers. It is found that calculations based on these two figures only, give too high a value for the starting resistance. Having given only the above two figures, show how the starting resistance for starting under, say, normal full load or twice full load can be obtained. Note that in general it is not possible to get the resistance of the rotor per phase from the makers.—" E. J."

Question No. 1231.—Will some reader state the chief items of meter maintenance and their relative importance and cost ? Also, which errors are most likely to occur, in the calibration, during use ? What is their magnitude, how may they be detected and how avoided ? How may a meter best be kept in good condition over long periods ?—" COLLIER."

ANSWERS.

Question No. 1226.—Bare wires of galvanised iron are used for signalling in a colliery. It is found that when the wires come in contact with the stone at the side of the road that the bells will still ring, but the positive gradually rusts away and the negative has a white deposit by it, which tastes salty. The pit is very dry. The wires have a trembling bell and 10 cells (cells in series) connected across them at distances of about 100 yards apart. What is the cause of corrosion and what is the salt which forms ?

Reply to Question No. 1226 (*awarded* 10*s.*).—Although the bells, in the circuit referred to, continue to ring satisfactorily when the bare wires are touching the gallery walls, this must be taken to indicate that there is no leakage occurring. The fact of the matter is that the circuit is very heavily batteried, and, though the pit is quite dry enough to enable the bells to ring all right, with this ample battery power, leakage is nevertheless occurring. The corrosion occurring is partly electrolytic, partly due to osmotic action, and partly due to direct chemical attack : the extent to which each influence is responsible for the damage is, of course, dependent on the local circumstances of the case.

Though the pit is " quite dry " in the ordinary sense of the words, there is, no doubt, ample moisture in the wall strata or condensed on the walls (particularly if they be holed in rock) to enable a tiny leakage current to flow from $+^{ve}$ to $-^{ve}$. The zincing of the positive is, in consequence, rapidly eaten away : subsequent corrosion is even more rapid, being partly electrolytic and partly simple rusting consequent on the removal of the zinc sheathing (also note that once the removal of the zinc is started it extends rapidly owing to electrolytic local action between the zinc and iron in the presence of moisture).

Now, the leakage current will not, under ordinary circumstances, injure the negative wire : this I gather has been observed by " A. L.," who notes the collection of a deposit but does not state that any corrosion of the negative is noticeable. However, the flow of leakage current will, together with precisely the same osmotic action as that which collects moisture round all negative cables (making their insulation so much lower than that of a positive cable, which is identical in every constructional respect), force a continuous stream of moisture towards the negative wire, where it will be held till it has evaporated. In evaporating, it will naturally deposit any solids which it held in solution, and so form a " deposit " round the negative wire.

In all probability, the present deposit was so formed, hence the salt will either be one contained in the moisture of the strata concerned, or will be a product of the electrolysis of the $+^{ve}$ wire (conveyed to the negative by the osmotic stream of moisture). Little, if any, of the deposit will be produced by corrosion of the negative, unless, indeed, the moisture conveyed has direct chemical action on the metal. It is possible that a certain amount of the deposit is traceable to the disposition of the wires, which allows a specially heavily deposition of moisture round the $-^{ve}$ (particularly when aided by osmotic attraction).

Further than these general remarks no precise information can be given without an actual analysis of the salts in question. Many substances have a saltish taste if taken in small quantities, and it would, of course, be very unwise to taste the present deposit in larger quantities with a view to making more certain on this point. If the deposit be present in fairly large quantities, " A. L." might conduct the following simple tests on a clean sample of the material :—

1. Dissolve, if possible, in water and add to silver nitrate solution : if a coagulating pinkish white ppt. forms, chlorides were present in the deposit : probably of Na or Ca. Sodium salts identified by yellow flame test.

2. Attempt to dissolve some of the deposit in HCl. ; insolubility will indicate possible presence of lead salts.

3. If salt is soluble in HCl. but yields no ppt. with H_2S (acid solution) but is pptd. by Am. in presence of Am.Cl.—iron or aluminium probable.

4. If, in (3), Am. Cl. gives no ppt., but Am.S or H_2S (alkaline solution) gives ppt. the salt is probably of zinc.

5. If, in (4), Am.S gives no ppt., but $Am.CO_3$ gives a deposit, then Ba, Sr or *Ca* salts were present.

6. If none of the above reagents give a ppt. the salt is probably of Mg, K or *Na*.

Conclusions.—If the deposit proves to be a salt of calcium, sodium, potassium, or, possibly, aluminium or magnesium, it will be traceable to salts present in the adjacent rocks or in the moisture dripping over same.

If the deposit is a salt of zinc it will be traceable to the corroded galvanising : if of iron, either to salts in the earth or to the rusting iron of the positive : if of lead (improbable) to adjacent lead work. Judging from the scanty particulars given, I should expect the deposit to consist, like stalactites, mainly of salts of the metals of the alkaline earths (Ca, Na, K, Mg, etc.).—" MINER."

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TORQUAY TRAMWAYS.

The Arbitrator's Award.

In connection with the dispute between Torquay Corporation and the Tramways Company, the award of the arbitrator takes the form of a special case, says the "Western Morning News," owing to the contention of the Corporation on a point of law that the arbitrator had no jurisdiction to deal with the matter. The arbitrator expresses his disagreement with the statement of counsel for the Corporation, that the right of the latter as to the system to be used on the Torbay-road was given as a consideration for the Corporation waiving its claim for a financial guarantee. The provision under Section 61, that the consent of any local authority as to the exercise of any powers shall not be unreasonably upheld, appeared to apply to every case throughout the Act, and therefore to the provision in Section 58, that the Torbay-road should not, except with the consent of the Corporation, be converted to the overhead system.

On June 21 the Corporation themselves resolved, if negotiations then proceeding proved abortive, to refer the matter to arbitration. At a preliminary meeting with the arbitrator the Corporation raised no objection as to jurisdiction. He asked the Court to state whether, if he had no jurisdiction, the Corporation had not waived their objection, and were therefore now debarred from raising it.

DOLTER *v.* OVERHEAD SYSTEM.

From the first the Dolter system was most unsatisfactory and expensive to work. On May 2 the Board of Trade gave notice that they would not renew their licence after October 31, and it therefore became necessary to adopt some other system. He found, as a fact, that, if the committee's terms had been accepted, they would have advised the Corporation to give their consent. The noise of the tramways was increasing by the contact of the skates with the studs. He (the arbitrator) concluded there was no reasonable ground for supposing that the amenities of the Torbay-road would be appreciably affected by the overhead system. The electric light wire would be carried on the tram poles of about the same height as the present standards. They would not obstruct the view of the bay, as they would be on the land side of the road except opposite the King's-road Gardens, and from the gardens the wire could not be seen by persons sitting down, as they would look right over it, and the number of standards would not be greatly increased. The æsthetic objection was based more on conservative tradition and a natural initial prejudice than on solid fact. He thought the majority of the Corporation were prepared to consent if they could get their price.

DOUBTFUL AND COSTLY EXPERIMENT.

He found that the G.B. system had proved on the whole a failure, and that the Loraine system would, under the prevailing conditions at Torquay, be a doubtful and costly experiment, and not likely to gain the approval of the Board of Trade. Owing to the discredit attaching to all the surface contact systems, it seemed that it would be impossible for the company to finance these systems, with the result that it must abandon its undertaking. The alternative, to construct tramway 4 and 4a (via Torhill-road and Lucius-street) on the overhead system had never, in fact, been offered to the company, and, if it had been, it was impracticable, unreasonable, and impossible, having regard to the character of the road and the fact that the capital spent on the Torbay-road would be sacrificed. There was a statutory duty to maintain the Torbay-road route.

The arbitrator stated that he had come to his decision without taking into consideration the fact that the company would, by a contrary decision, lose £140,000 capital, although he was of opinion that some weight might properly be attached to this. His award was to the effect that the consent of the Corporation had been unreasonably withheld, and he ordered the Corporation to pay the costs of the arbitration and award.

The Tramways Committee of the Town Council, to whom the matter had been referred back for consideration, held a meeting, but they came to no decision beyond agreeing to seek an interview with the representatives of the Tramway Company.

ACTON ELECTRICITY UNDERTAKING.

By 11 votes to 9 the Acton Urban District Council have decided to make over their electricity undertaking to the Metropolitan Electric Supply Company, Ltd. The terms of the agreement are as follows:—

Payment by the company of £2,500 as part consideration.

The Council to lease to the company at a fair rental the land on which the buildings are erected.

The company to take over the stores and other floating assets at a fair valuation, and to pay to the Council the interest and sinking fund charges on the loans for the purpose of the undertaking, subject to the Council continuing to use electricity for street lighting to the same extent as at present.

When the receipts of the undertaking amount in any year to a sum exceeding 6½% of the total capital expenditure, the company will make a further contribution to the Council of one half of such excess until the total payments shall reach £2,500.

For seven years the company is not to increase the scale of charges for electricity above the Council's scale in force on June 30 last, unless any unforeseen circumstances occur.

If the Council desires to re-purchase at the end of 42 years, five years' notice must be given.

It will be necessary to obtain Parliamentary powers for this transfer, and it is said that considerable local opposition will be offered, especially in view of the narrow majority obtained in the Council for the project.

BULAWAYO WATERWORKS.

The report of the Bulawayo Waterworks Company, Ltd., for the year ended December 31 last, states that the gross profit for the year from the sale of water and electric current amounted to £3,455 and £4,738 respectively, showing an increase of £130 on the sale of water and a decrease of £1,843 on the sale of electric current compared with the previous year. The profit and loss account for the year, after reserving £4,033 for depreciation and renewal of plant, and £1,537 on account of the expenses of the debenture issue, and after writing off £1,621, the costs of the arbitration arising out of the dispute with the Bulawayo Municipality, shows a loss of £1,981, which, added to the previous debit, brought forward from last year, makes a total balance of £6,068 to the debit of this account. The average number of water consumers during the year was 296—the same as in the previous year. The quality of the water continues to be satisfactory, and the supply, owing to the rains which fell during the early months of the present year, will, it is hoped, meet all present requirements; but in order to cope with any increased demand the board has arranged for the sinking of boreholes, and the water already struck has proved to be of a very pure quality. The average number of electric supply consumers during the year was 606, as compared with 578 in 1908. The loss of revenue from the sale of electric current is entirely attributed to the use of metallic filament lamps, which are now being generally used, both for public and private lighting. The rates of charge now in force, adopted under agreement with the municipality, will come up for revision in the early part of next year, when the board hope to secure the approval of the municipality to a fresh arrangement more equitable to the company under the altered conditions.

PERSONAL.

Mr. William Hockley, A.M.I.E.E., who has been resident engineer to the Frinton-on-Sea Electric Light Company since 1903, has left, with his wife and family, for Vancouver, B.C.

Mr. C. A. Blascbeck, electrical engineer to the Canterbury Corporation, has had his salary increased to £350 a year, while that of his assistant, Mr. Lewis, has been raised to £185.

A regular freight service has now been established through the double tunnel of the Michigan Central Railroad under the Detroit River between Detroit and Windsor, Ontario, the freight trains being drawn by electric locomotives. The tunnel work cost $15,000,000.

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PATENTS.

Electric Clock Driving Device.

27355.—1909. M. FALK, Erkrath. The oscillating armature of the circuit closing device serves to turn a loose conductor relatively to a spring. A non-conducting face is provided for breaking the circuit of the spring.

Electric Arc Lamp.

28555.—1909. L. M. MCBRIDE, Denver, U.S.A. This is an improvement in lamps provided with magazines for automatically supplying electrodes in succession to feed tubes which converge towards each other and in which the magazines for the electrodes are arranged to overlap each other and supply electrodes to the feed tubes from opposite sides. The improved feed tubes are made independent of the magazines and mounted in sleeves pivotted in stationary brackets in combination with means for spreading the tubes. Electrode stops are provided at the bottom of the tubes to arrest the downward movement of the electrodes.

Electric Ignition Devices for Internal Combustion Engines.

28818.—1909. H. BATT, Kelso. Two discs occupy the space on the armature spindle usually reserved for the driving connection. One of the discs is fixed by means of a key, whilst the other is loose. The loose disc engages the fixed disc by means of a slotted connection in a manner which ensures a certain amount of free movement. A spring is so arranged between the discs that the fixed disc, and with it the armature can only be rotated with respect to the loose disc, and therefore, to the driving connection against the action of the spring. The loose disc is coupled to the driving medium in any suitable manner.

Alternate Current Motors.

30208.—1909. V. A. FYNN, Blackheath. The object is to enable single-phase induction motors, having a member provided with a winding permanently closed upon itself, along one axis per pole pair, to start with a powerful torque per ampere. The invention consists of an alternating current motor comprising the combination with a primary member provided with a main inducing winding of a secondary member provided with a commuted winding and a second winding permanently closed upon itself and having a high ohmic resistance. The flow of current in the commuted winding is directed along two axes one of which coincides with the axis of the main inducing winding.

Brush Holders.

30331.—1909. W. A. STEVENS, LTD., AND A. T. LAMBERT Maidstone. The brush holder is formed in one piece with a square stud carrying the insulator. this ensures the holder being firmly held. The adjustable locking device of the finger levers comprises a pin which locks into a hole in a nut on the finger.

Electrical Induction Smelting Furnaces.

672.—1910. O. MULACEK, AND F. HATLANEK, Kladno. The fireproof part of the furnace which is in direct contact with the molten metal rests upon a layer of granular fireproof material sloping in the direction in which the part of the furnace containing the melting gutter expands when heated. This enables freer expansion of the bottom of the furnace, while at the same time the fractional co-efficient between the walls and bottom will be greatly reduced.

Portable Holders for Electric Lamps.

3977.—1910. BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago. The chief object is to provide a portable holder for electric incandescent lamps in which there is no possibility of short circuits being formed by reason of the holder being placed between live electric terminals, and in which there shall also be no possibility of a shock being communicated to the user by reason of it being thrown in contact with a live terminal. The lamp is provided with a protecting cage constructed and provided with locking means of insulating material and free from any metallic points.

Driving Mechanism for Petrol Electric Apparatus.

4681.—1910. FELTEN & GUILLEAUME LAHMEYERWERKE, A. G., AND F. COLLISCHONN, Frankfort a Main. The driving mechanism comprises a primary motor, a dynamo driven by the motor, two electric motors supplied with current from the dynamo each of which electric motors is connected to the wheels of the vehicle to be driven, a detachable clutch between the vehicle wheels and the primary motor and differential gear arranged between the vehicle wheels.

Electric Motor Controllers.

6867.—1910. CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee, U.S.A. This is a controller for two or more electric motors of the kind in which means are provided for changing the connection of the motors between series and parallel and simultaneously reversing the direction of rotation. One switch is provided for connecting the motors in series, while two separate switches are provided for connecting the motors in parallel and for ensuring reversal of the relative polarity of the armature and field of the motor.

Semi-Automatic Telephone Exchanges.

6964.—1910. SIEMENS & HALSKE, A.G., Berlin. A separate auxiliary selecting switch is provided for each connector which, when the connector is engaged by a calling subscriber connects itself automatically with the service lines of a disengaged operator, cuts this operator off from other connector switches and after the operator has transmitted the impulses necessary for the connection with the required subscriber frees the service lines of this operator and returns it to its normal position.

Single-Phase Commutator Motors.

7266.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. The improvement consists in connecting the ends of the compensation winding in single-phase operation to a portion of the winding of the motor feeding transformer.

Short Circuit Detectors.

7322.—1910. F. C. REINEKING, Jersey City, U.S.A. An arm is pivotted to the casing of the detector and connected electrically with one of the two electrodes carried in the casing. The arm carries a transparent member which covers the openings within the casing through which the appearance or non-appearance of a spark showing the state of the circuit may be viewed.

Telephonic Transmitters.

8024.—1910. E. A. GRAHAM, Brockley. The rings of elastic or yielding material between which the diaphragms of the microphonic transmitter are clamped are held in position by a ring forced into the diaphragm holder. This ensures the diaphragms being held in position free from subjection to uneven stresses.

Electric Searchlights.

8411.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. The arc lamp to be used as a searchlight has a metal coated negative carbon below which a tray is supported. This protects the carbon from the hot flames from the arc and serves to catch the metal drops which fall from the carbon that would otherwise fall on to the mirror of the searchlight.

Telephone Systems.

10577.—1910. E. A. GRAHAM, Brockley. The object is to provide improved means for calling in circuits supplied through main possessing inductance combined with arrangements for giving a direct call by voice and avoiding the necessity for operating the local switch at the called station. The means for originating a call comprises a vibrator which provided current fluctuations in the receiver such as to produce the required calling sound. The vibrator is either placed in series with the distant receiver so that the diaphragm vibrates in unison, thus giving an audible signal or the vibrator may be connected in parallel with the distant telephone transmitter and receiver, or it may be with the receiver only.

Electrical Warp Stop Mechanism for Looms.

11761.—1910. C. KLEIN, Götenborg. The warp stop mechanism comprises healds which when the warp threads break meet a contact rail which rises when the heald frame descends. At the same time the heald frame and the rail become connected with the electric source to bring the loom stopping mechanism into operation.

Variable Electric Transformers.

11903.—1910. R. A. FESSENDEN, Brant Rock, U.S.A. The transformer consists of two coils of wire wound on relatively adjustable insulating cylinders. The coils form the primary and secondary of the transformer. One or both the coils are arranged so as to be wound on or unwound from one of the insulating cylinders. The cylinder itself is moved axially so as to alter the mutual inductance between the two circuits.

Driving Dynamo Electric Machinery for Train Lighting.

13502.—1910. A. G. BROWN, Boveri et Cie, Baden. An arm is provided in direct or indirect connection with the dynamo housing and can be swung vertically, horizontally, or in any other required direction. The arm takes the place of the universal joint couplings hitherto employed for communicating the drive.

Magneto Generators.

14315.—1910. LA VERNE W. NOYES, Chicago. This generator includes a compound permanent magnet provided with spaced apart portions near its polar ends. Polar pieces intermesh and terminate with the spaced apart portions. A structure engages and holds the pole pieces where the intermeshing does not occur and also forms a support for the movable member of the generator.

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Protecting Devices for Underground Cables.

10054.—1910. J. AND A. ETTLINGER, Germany. The devices consist of single castings provided with pins and recesses and made to overlap and engage one within the other so that the castings are hinged together at the ends on all sides and so that the cable can be exposed by merely lifting the upper moulded part.

Armature Windings of Dynamo Electric Machines.

11896.—1910. SIEMENS BROS. DYNAMO WORKS, LTD., Westminster, S.W. Armature coils with stepped windings are employed consisting of coils without joints at their back ends. The collective insulation of those half coils which lie side by side in the top of any armature slot is performed after the coils have been assembled round the circumference of the armature coil.

Signalling Apparatus Operated from a Distance.

14355.—1910. SIEMENS & HALSKE, A.G., Berlin. In order to obviate certain drawbacks in the signalling method disclosed in Patent Specification 14240.—1909, the detent magnets are formed as polar extensions of the main magnets. The polar extensions act as a magnetic shunt to the main field of the instrument.

Automatic Telegraph Transmitter.

15123.—1910. L. M. POTTS, Baltimore, U.S.A. In this transmitter the transmission of signals is controlled by a prepared page sending blank which itself controls the means for bringing about its operation.

Electric Arc Lamps.

13728.—1909. F. W. E. SCHUER, London, W.C. The lamp is hermetically sealed in all its parts with the exception of a long narrow outlet for the over-pressure of gases generated within the lamp. The outlet consists of a finely bored upwardly extending coil 3 ft. 6 in. in length and connected to the lower part of the lamp. While this outlet releases the over-pressure gases it also resists the entrance of oxygen into the lamp, thereby preventing explosions and retarding the combustion of the electrodes.

Device for Automatically Switching On and Off Flash Signs.

16885.—1909. A. H. BRACKENSIECK, Mill Hill. This is an improvement in apparatus for automatically and continuously making and breaking the circuit of an electric current of the kind in which an electro-magnet or solenoid is employed to actuate a lever against the mechanical action of a mechanical or other form of resistance operating in both directions of the lever's movement. The object is to produce an apparatus which shall be capable of adjustment in various ways to admit of a number of variations in the time taken to make and break the current.

Arc Lamps.

19387.—1909. S. C. MOUNT, AND BECK FLAME LAMP, LTD., Hayes. This is an improvement in lamps of the multiple carbon type. The object is to provide improved means for striking the arc. A controlling member is provided in connection with the operating lever of the striking mechanism and is adapted, according to its position, to cause the separation of one pair of carbons before the others when striking occurs, and so to ensure that the arc shall be struck upon the pair of carbons separated last. As the first pair of carbons burns away the carbon holder is gradually moved into a position in which it can directly or indirectly act upon the controlling member to cause it to move the second pair of carbons nearer together so that the arc is restruck upon the second pair of carbons.

Driving Mechanism for Use with Electric Motors.

19496.—1909. W. G. BAMBRIDGE, Kettering. The invention is particularly applicable to speed reducing mechanism employed with an electric motor for driving portable drills and analogous tools by means of a flexible connecting shaft. The mechanism comprises a countershaft with a pulley rotatably mounted upon it, a cone slidable along and rotatable with the countershaft pressed into the bore of the pulley by means of springs arranged in combination with the cone, and bearings furnished with rotatable eccentric sleeves adapted to carry the countershaft. The sleeves are provided with handles by which they are rotated, and ratchet teeth engaged by a pawl to prevent backward movement.

Homopolar Generators and Motors.

21179.—1909. R. H. BARBOUR, Crawley Down. The collector rings are supported round their shaft or armature core either in a single group or in a number of groups in such a manner that with the exception of the outermost rings of each group all of the rings will be entirely free from contact, either direct or through insulating or other packing pieces, with the shaft or core, whilst an uninterrupted air space will extend all round the core between it and the collector rings. By this method of support safer insulation with less insulating material is obtained, together with greater facilities for cooling.

Switch for Breaking Electrical Circuits.

21343.—1909. W. C. KIRWAN, AND K. QUANEY, Dublin. This switch comprises a casing enclosing a cylinder and piston, the one movable in relation to the other. The cylinder is held in position at the top of the case by means of a spring mounted on the piston and pressing against one end of the cylinder. A handle and catch are attached to the cylinder by means of which the cylinder is moved to compress the spring and change the position of the piston. Jets of air or fluid are directed from the interior of the cylinder on to the contacts according to the position of the piston.

Prevention of Brush Sparking in Rotary Electric Frequency Transformers.

23291.—1909. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. The improved means for promoting sparkless commutation consists in running the transformer above synchronous speed and in providing neutralising fields which have the same direction as the main starting field for neutralising the voltage which would otherwise be induced in the short circuited rotor coils by the action of the unaltered main field.

Refractory Insulating Materials.

23351.—1909. GENERAL ELECTRIC COMPANY, Schnectady, U.S.A. It has been discovered that if titanium in some form is introduced into the silicates at present used in electric and heat insulating materials, the toughness and refractory quality are greatly improved. Talc, hydrated silicate of magnesium and clay, and a hydrated silicate of aluminium are all compounds much improved by the addition. A solution of sodium or potassium silicate is a good binder for the above silicate and titanium compound.

Electric Signalling Means.

23747.—1909. E. A. GRAHAM, Brockley. The invention provides means for transmitting a signal by means of a single impulse of electric current. The operating mechanism comprises, for co-operation with the curved race of the movable switch element, a cam plate having a loose connection with the spring influenced spindle of an operating handle and a two-step ratchet pinion and locking detent for controlling the spindle. An indicator apprises the operator that the electrical circuits are in working condition.

Electric Plug and Socket Connectors.

25719.—1909. N. HOSGOOD, Dublin. The invention consists of an equilateral triangular arrangement of sockets and contact pins whereby the plug and socket holder may be placed together in a number of ways so that different contact pins and sockets are engaged each to each respectively. Marks are provided on the socket holder and plug for indicating the particular electrical contact made when the holder and plug are in position each to each.

Switching Device.

26088.—1909. W. C. KIRWAND, AND K. QUANEY, Dublin. In this improved rocking mercury switch the contacts form a hinge on which the mercury cup is mounted. For this purpose the projecting ends if the contacts are bent at right angles. The switch can be used in connection with electric lighting or power and is specially suitable in positions exposed to weather where switches of the spring and other types generally fail.

Inductance Coils for Electric Cables.

26250.—1909. SIEMENS BROS. & COMPANY, LTD., AND W. DIESELHORST, Westminster. The object is to prevent moisture from percolating through the external non-hygroscopical covering and penetrating to the hygroscopical insulating material with which the cable is covered. A sheathing of tinfoil is, therefore, interposed between the hygroscopic and non-hygroscopic material, or, if preferred, the tinfoil layer may be placed between the layers forming the non-hygroscopic material.

Electric Action for Organs.

27175.—1909. C. BAMBERGER, Derby. Two blocks of insulating material are provided. The lower block is fixed on the inner end of each key or upon some part operated by the key. The upper block is carried by an adjustable spring. Both blocks have a central contact pin to which terminals are screwed at the outer ends to secure the electric wire in position in the case of the bottom block, and to secure one end of the spring to which the wire is connected in the case of the upper block. Both blocks are always in contact with their meeting surfaces perfectly flat so that aid is prevented from coming in between the two contact points and causing sparking.

Support for Electric Incandescent Lamps.

27208.—1909. R. B. BENJAMIN, Chicago. The support consists of a divided block of insulating material one portion of which carries spring contacts for the lamp while the other portion carries the lamp support itself, together with a cover for protecting the binding terminals and ends of the lead conductors.

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NOTES.

Rail Corrugation.

At the International Tramway Congress, Brussels, Herr A. Busse, Chief Engineer of the Berlin Tramways Company, on behalf of his committee, gave a brief report on Rail Corrugation. There was, however, little that was new in it. The point emphasised was that it was the rail itself that was at fault, or, rather, the metal of which it was composed : " the prolonged investigations carried out prove without doubt that even before the rails are actually used in service the metal contains within itself the germs which produce corrugation directly service is started." But it is still maintained that the chief contributory causes are hardness of tyres, sudden application of brakes, rapid acceleration, side rolling and skidding, awkward curves. An American authority, Mr. J. H. M. Andrews, Assistant Chief Engineer of the Philadelphia Rapid Transit Company, by the way, adds to the above factors : Tight track gauge, flat spots on wheels, which tend to uneven pressure and so to flatten out the surface of the rail, and bad foundations. As regards Continental work, the German Tramways and Light Railways Association have appointed a special committee which will, in conjunction with Dr. J. Puppe, the well-known metallurgical engineer, investigate the composition of rails and other causes of corrugation. The Union Internationale is, with the assistance of a sufficient subsidy, to continue its investigation. Professor C. A. Carns-Wilson is a member of the latter committee.

Electricity and Automobiles.

Several points of considerable interest to electricians were dwelt upon by Mr. F. W. Lanchester in his presidential address before the Incorporated Institution of Automobile Engineers. Touching upon driving, he pointed out that there were three alternatives to mechanical change gear : (a) Hydraulic transmission, (b) electrical transmission, and (c) electrical auxiliary. When either of the first two are employed they may either be arranged as direct substitutes for the change gear-box, or they may be made to operate direct from motor to road-wheels, so doing away with the right angle drive (bevel or worm), and even the differential. Both arrangements, Mr. Lanchester argued, possess advantages and corresponding disadvantages. When the complete transmission is effected by a single step, either hydraulic or electric, there is the saving of two to four mechanical transmissions (depending upon whether the direct drive or a gear would have been in use), to set off against the hydraulic or electrical losses ; on the other hand when the gear-box alone is replaced, the loss of the bevel or worm gear still remains (amounting to roughly 10 per cent. of the power transmitted), but it is possible to utilise a form of hydraulic transmission in which the difference of torque between the motor and arbor shafts alone is taxed, such gear being strictly the analogue of an epicyclic gear of variable ratio. Such a gear has been proposed many times, and has been used experimentally more than once ; the Hall hydraulic gear is a typical example, and was probably the first of its kind. More recently it has been proposed to use an electrical transmission designed on the same principle, though experiments in this direction have been carried out, he had not heard of any successful results.

Double Hydraulic Transmission.

On the question of efficiency, as Mr. Lanchester explained, some divergence of opinion exists. The best results obtainable with a double hydraulic transmission, *i.e.*, overall efficiency pump and motor, are in most cases under rather than over 70 per cent., though recently it has been reported that tests of a rotary pump and motor of novel form have shown as much as 80 per cent. On the basis of direct transmission from motor to road wheels this latter would give the hydraulic transmission as about 10 per cent. inferior to the direct drive, but about the same as the present efficiency when driving through the gears ; such a result if confirmed by later tests would be most hopeful. On the 70 per cent. basis the inferiority of the hydraulic gear would vary from 10 per cent. to 20 per cent. according to whether compared to the gear drive or direct.

Electrical Transmission.

The lecturer thought that we could scarcely hope to obtain such good efficiency from an electrical transmission, for owing to considerations of weight the results obtainable in stationary work do not apply. It is improbable that it is " commercial " to use dynamo and motor of more than 55 per cent. or 60 per cent. overall efficiency, hence it is improbable that this type of gear can ever come into use unless in exceptional cases. Beyond this, it is in the majority of cases not possible by electrical means to drive direct on to the road wheel axles, so that one gear transmission must be retained, and the efficiency will be reduced accordingly.

The epicyclic analogue possesses certain attractions ; again, the electric transmission will, compared to the hydraulic, be at a disadvantage. It is possible that some reconsideration of this form of hydraulic drive may result in something of real commercial utility. On the equivalent of the direct drive the hydraulic loss is zero, and (at 80 per cent. for the double transmission) the efficiency would be superior to the ordinary gear-box transmission over a comparatively wide range.

Electric Auxiliary.

Passing to the consideration of the third alternative, *electric auxiliary*, we find the use of electrical power as an auxiliary means of propulsion opens up a new field of possibility ; we have no longer to deal merely with a substitute for change gearing, but with a combination possessing certain valuable properties of its own that are clearly destined to play an important part in the future development of the automobile.

The Future.

It will be appreciated from the detailed discussion of the subject that the future of the petrol-electric auxiliary system more widely than at present in contemplation must rest largely with the question of accumulator weight, not the weight per h.p. hour, that is the energy content, but rather the h.p. output, *i.e.*, the *rate of doing work* ; at present the best results commercially attainable for brief discharges of but a few minutes duration is the equivalent of one h.p. per 40 lbs. weight. This is reasonably satisfactory for vehicles of moderate speed—less than 20 miles per hour—but it is not good enough for the pleasure vehicle. If the battery weight could be reduced to 20 lbs. per h.p. the later as a proposition would be worthy of serious consideration.

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Northampton Polytechnic Electric Generating Station.

As recently announced in our Educational Column, the Northampton Polytechnic Institution has considerably extended its sphere of practical usefulness by the building and equipment of a fine electric generating station, which was formally opened last week. Although, of course, not so large as a central station for a town or district supply, it is complete in itself, and, indeed, contains more interesting features and appliances than could be well found in the average run of such establishments. The station, which is to be in charge of the staff and senior students, will be managed on strictly business lines; all items of expenditure—coals, wages, etc., will be charged against the establishment, while all units used in the institute for lighting, heating and power will be measured through meters and charged against the institute, so that a proper balance sheet and profit and loss account can be made out. In a few words, the generating station is to be utilised as a means of practical initiation, where the students may test their knowledge under conditions prevailing in actual business. It must be remembered that the Polytechnic is a five-storied building, covering considerably over an acre, and comprising a number of workshops, laboratories, etc., run under the varying conditions for the different classes carried on. There will, consequently, be quite a sufficient demand and diversity to afford a very thorough training.

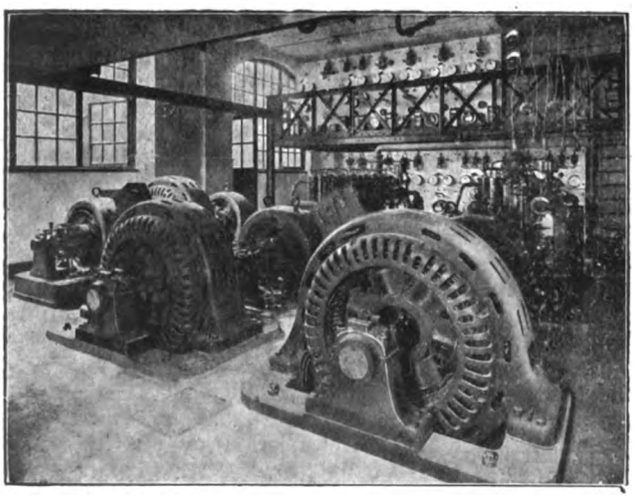

FIG. 1. GENERAL VIEW OF GENERATING STATION.

The plant is of a more complete character and rather more varied than is usually found under one roof, but this is all to the advantage of the student.

There are two gas-driven sets, each consisting of a continuous-current generator and a high-voltage alternator in tandem. The suction gas producers were manufactured by Messrs. Bennett & Tapley, of Southampton. The gas engines are of the Gardner suction type, and were supplied by Messrs. Norris & Hentz, of Queen Victoria-street. Each is capable of developing 108 b.h.p. at 500 r.p.m. Each engine has six cylinders of 8 in. diameter and water jacketed. A centrifugal governor is used, and forced lubrication is fitted to most working parts, while the starting is effected by compressed air. The ignition is by means of an electric spark from a low-voltage magneto, driven by direct gearing from the crank-shaft. A water-jacketed silencer is fitted along the front of the cylinder, and the engines are provided with cooling water tank and indicators. The compressed-air starter consists of an air compressor belt-driven from an electric motor. The cooling water supply is derived from the swimming bath close at hand, but two cooling tanks of 620 gallons each are provided for emergencies.

Gas for the engines may be provided by the suction gas plant, or be drawn direct from the company supply.

The normal speed of the main shaft of each set is 500 r.p.m. Coupled in tandem to each engine are: One Siemens 280 FC. compound-wound generator, having an output of 0/50 kw., 210/220 volts, and capable of shunt regulation by hand between 200 and 230 volts, the fields being over-compounded. As already stated, direct coupled to each generator is a Siemens 35·7 U.R. three-phase alternator having an output of 50 k.v.a., or 42·5 kw. at a power factor of ·85 and a pressure of 2,200 volts, the frequency being 25 cycles per second. These alternators are of the rotating field type, with six poles.

Another feature of this installation is the Siemens motor-generator set, consisting of one 35·5 U.R. three-phase synchronous motor of the two-bearing type, direct coupled to two 260 FC. compound-wound generators, one generator being coupled on each side of the motor, and the three machines mounted on a combination bedplate. The synchronous motor has an output of 45 b.h.p. at 2,200 volts, 25 cycles per second, and runs at a speed of 500 r.p.m. The excitation is taken from one of the continuous-current generators. Generator No. 1 of this motor-generator set has an output of 0 to 25 kw. at 215 to 220 volts, and is capable of shunt regulation by hand down to 200 volts. Generator No. 2, which for starting the set may be run as a motor, gives an output as a generator of 0 to 27·5 kw. at 107 to 110 volts, and is capable of shunt regulation by hand down to 100 volts. The general mechanical design of the synchronous motor is similar to that of the U.R. alternators described above. This set is also equipped with the necessary series and shunt regulators and a continuous-current starter.

The switchboards in the station have been designed with the object of permitting the maximum number of interchanges between the various units of the plant, and of converting and controlling the electric energy in the station so that, as far as is possible on the scale of the station, modern station and sub-station practice, both with continuous and alternating current, may be demonstrated.

There are four switchboards: One high-voltage three-phase 2,200 volt, 25 cycle switchboard, consisting of two generator panels, one synchronous motor panel, one transformer panel.

The transformer panel controls the high-voltage side of four 13·7 k.v.a. transformers. In addition to the usual switchgear and instrument transformers, these panels are provided with the following: Recording ammeters, watt-hour meters, recording voltmeters, power factor indicators, frequency indicators, rotary lamp synchroscope and reverse-current relay.

The high-voltage gear is mounted in cells, built of artificial stone slabs, the front of the cells being closed with expanded metal screens. This gear is in an adjoining room, and is operated from the desk-type switchboard by a system of remote mechanical control.

The low-voltage three-phase 350-volt 25-cycle switchboard consists of one rotary converter panel to control the rotary converter in the adjoining room; one transformer panel to control the low-voltage side of the four 13·7 k.v.a. transformers; and two feeder panels equipped with the latest type of switchgear.

The cases of all the instruments on these boards are effectively earthed, and no apparatus at high-voltage is accessible from the front of the board. The high-voltage alternating-current board mentioned above is of the "desk" type, while the low-voltage alternating current board is of the "vertical" type. These two boards are placed in a gallery at one end of the power station, at the opposite end of which is situated the low-voltage continuous-current main switchboard, consisting of two generator panels, each 50 kw.; one generator panel, 25 kw.; three booster balancer panels; one rotary converter panel; one generator panel, 27·5 kw.; three feeder panels,

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200/220 volts; one feeder panel, 500/550 volts; and two feeder panels, 100/110 volts.

The low-voltage board is divided into two parts, one mounted above the gallery and one immediately beneath it. The high-voltage A.C. switchgear is mounted in stone-work cells in a separate room.

Each generator cell is equipped with one triple-pole oil switch of the Stafford type, having a capacity of 100 amps.; five current transformers having a ratio of 20/5 amps.; one three-phase potential transformer having a ratio of 2,200/110 volts; three single-pole high-voltage potential transformer fuses; and three single-pole isolating switches, each of 50 ampere size.

The transformer cell, as will be seen from the illustration, has a similar equipment, with the exception of the potential transformers and the potential transformer fuses. Side by side with these cells are placed those containing the transformers mentioned above, also protected in front by an expanded metal screen.

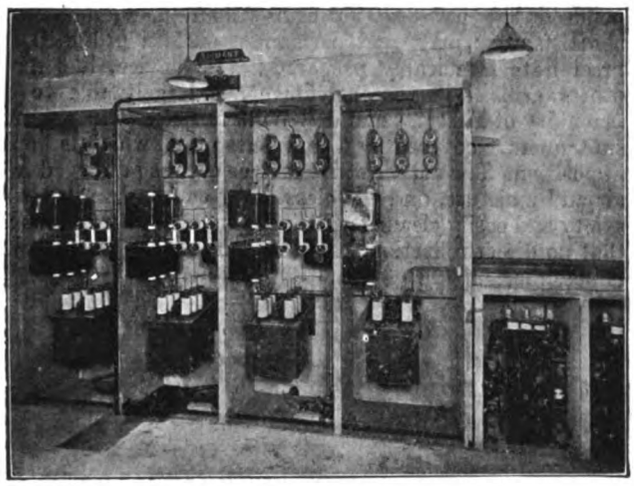

FIG. 2. HIGH-VOLTAGE SWITCHGEAR TRANSFORMERS AND CELL WORK, WITH SCREENS REMOVED.

In this room there is also a four-pole rotary converter three-phase current to continuous current, this machine being fitted with three slip-rings and damping winding. The output on the continuous-current side is 30 kw. at a voltage of 500 to 550, the corresponding alternating-current voltage being 310 to 350 volts at a frequency of 25 cycles per second. The set runs at 750 r.p.m. The machine is started up from the A.C. side as an asynchronous motor by means of auxiliary tappings on the low-voltage side of the transformers referred to below. The shunt field is divided into three sections and brought out to six terminals, so that during starting the field can be broken up and each section put in parallel with each other to prevent a high induced voltage breaking down the insulation.

In one of the laboratories, situated some 100 ft. from the main station, there is installed a switchboard which will be used as the switchboard of a sub-station receiving power commercially from the generating station through its own recording instruments, etc., and distributing the power to the building. The details of this switchboard are as follows: One incoming feeder panel for two 400 ampere circuits; one auxiliary generator panel; one auxiliary balancer panel for 10 kw.; two feeder panels; and one busbar coupling panel.

These panels are provided with suitable switchgear for carrying out the various tests desired in such an installation. The transformer equipment consists of four single-phase air-cooled transformers, each having a capacity of 13·7 k.v.a., with a primary voltage of 2,200 and a secondary voltage of 330, the frequency being 25 cycles per second. Working in conjunction with these are three regulating transformers having a primary voltage of 330, and tappings on the secondary for giving nine different voltages from 310 to 350 volts. These tappings are connected to a rotary switch operated by chain gear from the switchboard.

The station equipment also includes a battery consisting of 106 cells manufactured by the D.P. Battery Company, Ltd., of Bakewell, and capable of giving a discharge of 60 amps. for 10 hours, 100 amps. for five hours, or 130 amps. for three hours, the E.M.F. of the battery not falling below 1·8 volts per cell.

Working in conjunction with this battery is an automatic reversible booster balancer set, consisting of three machines coupled together and mounted on a combination bedplate.

The two machines composing the balancer are capable of dealing with an out-of-balance current of 65 amps. in the middle wire, the voltage across the outers being 200 to 220. It is also capable of dealing with the full-load output of the battery, keeping the load on the generators constant within 10% of the fluctuation on the outgoing feeders, and keeping the potential difference on the lines within 2%., *i.e.*, 1% up or down. This set, which runs at about 930 r.p.m., is complete with balancer middle-wire regulator, booster shunt-regulator, booster-potentiometer shunt-regulator, and the usual switches and resistances.

To complete the station there has been erected an overhead electric travelling crane of two-tons lifting capacity, with lifting, travelling and traversing gears operated by three Siemens series-wound electric motors and controllers. The span of the crane is approximately 23 ft. and the lift 18 ft.

The maximum speeds of the crane with two-ton load are as follows:

Longitudinal travelling	..	150 ft. per min.
Cross traversing ..	..	75 ,, ,,
Hoisting	..	15 ,, ,,

Lighter loads can, of course, be dealt with at a correspondingly higher speed. This crane was manufactured by Messrs. Higginbottom & Mannock, Crown Iron Works, West Gorton, Manchester.

The ventilation of the engine-room is carried out by means of a fan sucking the air down through sleeve pipes, which rise up into the engine-room around the exhaust pipes of the engines, fresh air entering through windows and grid ventilators at the top.

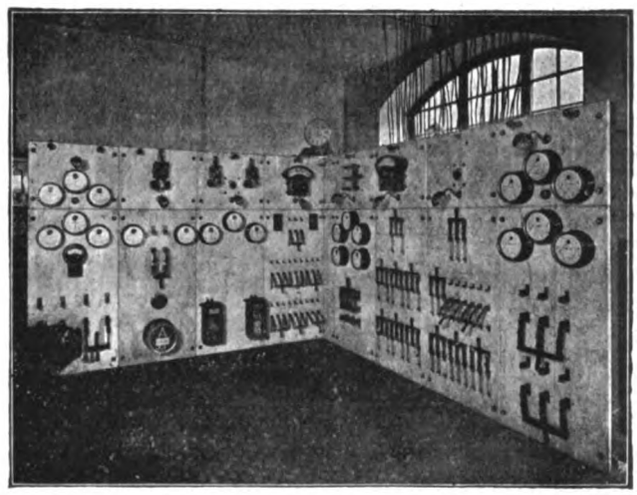

FIG. 3. SUB-STATION BOARD.

There can be no doubt that this generating station will not only conduce to the economical and efficient working of the institution in all its departments, but provide that very experience with practical problems of everyday practice so necessary for the thorough training of an electrical engineer.

Certainly the Northampton Polytechnic Institution, Dr. Walmsley and his staff, the students and the contractors are to be congratulated on the successful way in which this great improvement has been carried out.

SIEMENS RUBBER TAPES AND SOLUTION.

We are informed by Messrs. Siemens Brothers & Company, Ltd., that the net prices for their india-rubber tapes and solution (in Catalogue No. 510 and Reprint No. 510A), which came into force on April 8, 1910, have been reduced by 20 per cent., as from Monday, October 17.

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A New Instrument for its Measurement.*

By J. S. Dow and V. H. Mackinney.

It was early recognised as important that the gas supplied should have a certain specified illuminating power, and tests were laid down to secure compliance with a certain standard. Subsequently it was recognised as equally important to test the source of light. As early as 1882 Sir Wm. Preece pointed out that although measurements of the illuminating power of sources of light are very desirable, yet they do not strictly speaking, yield us the result with which we are ultimately concerned. What we are really anxious to know, he pointed out, is not only the light of the lamp given by the lamp used, but the actual intensity of illumination " on the surface of the book we are reading, or the paper on which we are writing, or of the walls on which we hang our pictures," etc. He therefore proceeded to describe an instrument for the measurement of illumination. Since that date a large number of instruments of this kind have been designed, and have done good service.

Yet it might be argued that even a measurement of illumination does not exactly describe practical conditions. What really concerns us is not only the illumination arriving on a surface, but the actual " surface-brightness " which results. For example, it may happen that a good illumination is provided to show off the wall-papers in a room. But if these are of a very dark tint only a fraction of the light reaching them is reflected again. What is really necessary in such cases is to secure that the walls have a definite brightness. In the same way it may be urged that it is the surface-brightness of the page of a book, after a certain amount of light has been lost owing to absorption by the paper, that enables us to read, and it is the contrast between the brightness of adjacent objects which enables us to distinguish one from another. The authors are, therefore, disposed to suggest that the measurement of this quantity would often be of considerable service in connection with practical lighting problems. Naturally this does not mean that the measurement of illumination is superfluous, nor that it is not still as essential as ever to measure the candle-power of the lamps we use or the illuminating and calorific value of the gas we consume. But the measurement of surface-brightness would seem to be an important link in the chain of processes connected with the study of illumination, all of which have their sphere of usefulness.

The " Lumeter " Surface-Brightness Photometer.

It occurred to the authors that a description of a new form of instrument, primarily designed for the measurement of surface-brightness (though it can also be used for other purposes) might be of interest. It is to be distinguished by the name " Lumeter."

The instrument was described in its crude form at a recent meeting of the Illuminating Engineering Society, but since that date its principle has been studied more carefully, and a number of improvements have been introduced and difficulties overcome.

Description of the Instrument.—The general appearance of the apparatus is shown in Fig. 1.

The idea of the instrument is to enable an observer to measure the surface-brightness of any surface by comparing it direct with a standard illuminated white one. The manner in which this is done will be understood from Fig. 2. The observer looks direct at an illuminated screen and sees, through an aperture therein, the illuminated surface to be studied—for example, a picture, or some object in a shop window. This screen is illuminated by an opal glass plate. Behind this is a small metallic filament glow-lamp at a sufficient distance to render the screen of uniform brilliancy. In the illustration, the screen, with its circular aperture, has been taken out and will be seen resting against the box. The sector-shaped opal surface can also be clearly noted.

The screen has been made by depositing a matt white precipitate on thin glass and then scraping away a central disc. In this way a very fine line of division between the photometric surfaces can be secured. There were certain initial difficulties to overcome in this method, but it is believed that there seems to be now no difficulty in securing a satisfactory matt and permanent surface provided the precipitate is suitably prepared; this device, like many others utilised in the instrument, is largely due to the ingenuity of Messrs. Conrad & William Beck. The screen is subsequently covered by a thin glass plate, which is bound in position. The actual white surface is thus preserved from air and moisture, and the glass cover can be handled with safety and easily cleaned. The position of the screen is such that no direct reflection from this surface into the eyepiece is possible.

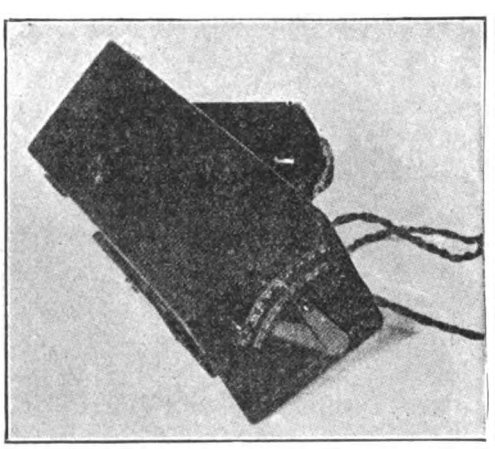

Fig. 1.

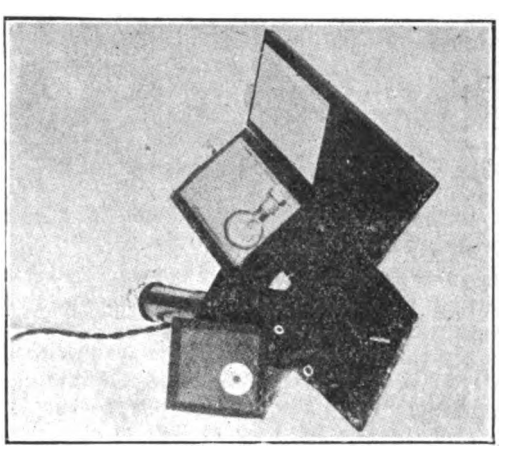

Fig. 2

The method of altering the illumination is somewhat unusual. The screen S (see Fig. 3) is covered by an opaque diaphragm D, which only allows a sector to be exposed. In front of this evenly illuminated sector two corresponding opaque screens, attached to levers A and B, can be made to pass. As the screen A is moved in front of the sector its area, and therefore its intensity as a light-source, will be uniformly diminished from, say, 1 to 0·1. The remaining intensity, 0·1, is derived from the part of the surface still visible through the ring R. The area of R is arranged to be exactly 1-10th of the total area of the bright sector. The lever attached to A therefore travels on an equally divided circular scale with 9 divisions from 1 to 0·1.

Having drawn across the lever A, we can gradually reduce the illumination still further by also bringing over the lever B. This exactly resembles A, with the exception that there is no ring cut out. In doing so we gradually cut off the illuminated portion of the opal plate still left exposed and reduce the illumination uniformly from 0·1 to 0. The lever B travels on a second scale immediately above that of A, graduated from 0·1 to zero.

Method of Calibration.—A word or two may be said regarding the units in which the scale ought to be calibrated. Strictly speaking, the instrument measures " surface-brightness " or " intrinsic brilliancy." This may be expressed either in terms of " candles per square centimetre " or in terms of the illumination in lux or foot-candles which a truly white surface would have to receive in order to have an equivalent brightness. The latter is the method most suitable for most practical purposes, and has been adopted in this instrument.

(To be continued.)

* Abstract of paper read before the Optical Society, London, October 13th, 1910.

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THE ENGINEERING AND MACHINERY EXHIBITION, MANCHESTER.

This great exhibition has now been opened and is attracting large crowds of engineers and others interested in machinery. The hall is packed to its fullest capacity with exhibits of the most varied kinds and of universal interest. The whole show reflects the very greatest credit on the management and on the "Engineering Review" for their enterprise in organising it.

The Luncheon.

Preceding the opening ceremony, a luncheon was held in the Midland Hotel Banqueting Hall, presided over by Sir William H. Bailey, F.R.G.S., and attended by representatives of the firms exhibiting. The principal guest was of course, Sir George Reid, the High Commissioner for Australia, who came down to Manchester specially to open the show. Among others present were the Lord Mayor of Manchester (Councillor Chas. Behrens), the Mayor of Salford (Alderman J. Snape), Mr. J. A. F. Aspinall, President, Institution of Mechanical Engineers; Dr. Nicholson, of the Manchester School of Technology; Mr. J. S. Peck, Chairman of the Local Section, Institution of Electrical Engineers; Mr. Frank Foster, Mr. J. K. Bythell, Chairman of the Manchester Ship Canal.

Mr. J. A. F. Aspinall, proposing the toast of the "Empire," spoke of the very close relation which had always existed, right from the days of the Roman road builders to the present time, between the engineer and the Empire. This connection was ever becoming closer. The great canals of the world had been the result of the imperial idea. As soon as we got territory our first care was to establish easy means of communication. How important this was, was shown by the disorganisation of France by the railway strike.

Sir George Reid, replying, pointed out that Canada and Australia comprised seven-twelfths of the territory of the Empire. We were beginning to realise what the Empire really meant and to give that attention to these great portions of it which was formerly expended in watching the affairs of some of the little States of Southern Europe. The Empire was administered in the interests of those who lived in it, and he considered that the civil administrations in its far-distant parts constituted the greatest glory of the race and the British Empire. Ninety-five or 96% of Australians were either born in England, or were the children of people born here, and the stronger and richer they got the more their feelings of loyalty expanded to the land whence they came. Referring to the "decadence of England," he had not been able to detect any signs of decay; on the contrary, he was everywhere struck by the very distinct signs of industrial health and vigour. He believed there was a time of greater prosperity than ever in store for England. Manchester, he said, was one of the greatest models of industrial enterprise the world had ever seen.

The toast of the "City and Trade of Manchester" was proposed by Mr. J. K. Bythell, who said that Manchester men were never content to let things do. When they found that owing to transit difficulties some of their industries were languishing, some of them conceived the idea of Manchester as a seaport, and the result was that now a great engineering undertaking—the Manchester Ship Canal—whose traffic last year was 5,000,000 tons, and by which steamers of 500 feet in length and of 10,000–12,000 tons burden often came right into the district, was an accomplished fact, and was succeeding in bringing greater prosperity than ever to the city. A great feature of the undertaking was that it had not damaged the trade of Liverpool, as had been foretold. On the contrary, Liverpool trade was now itself greatly improved, and, furthermore, Liverpool had greatly reduced its dock rates in competition with the new inland seaport. Cheap transit encouraged traffic, and traffic meant greater prosperity to the whole district. The engineering equipment of the Manchester Ship Canal was so complete, that foreign and colonial dock commissions frequently paid visits. On two occasions recently the Commissioners of the Clyde Ports had come down to see their arrangements before making their own extensions.

The Lord Mayor, in reply, referred to the proposed amalgamation between Manchester and Salford. It was the proposal of Sir William Mather, but he had very willingly welcomed the scheme, because he thought it would be to the interests of all concerned, that such an amalgamation should take place.

"Success to the Engineering and Machinery Exhibition, 1910," was proposed by Prof. J. T. Nicholson, D.Sc., who referred to the great educational value to every cultured person of such exhibitions. Mere money-making was not the direct object of such exhibitions, but the increasing of knowledge, and he, therefore, thought that it was peculiarly the province of an engineering journal to organise such a show. He suggested that a permanent exhibition of machine tools, such as existed in Berlin, would be of the greatest value to the district and to the firms, the exhibits being kept up-to-date. He spoke of the wonderful selection of tools shown and of the great ingenuity which their design exhibited. There was, however, great need of more scientific investigation of tool-shop problems. The measurement of the cutting efficiency and power of a lathe head stock was one. In conjunction with Mr. Dempster Smith, he had devised a method, hitherto unnoticed in England, but which was being well received abroad, by which from the speed and torque curves he had been able to show that many of the speeds usually provided were not only not needed, but were actually less efficient than lathes with fewer speeds. There were many conventional features of machine tool design which were open to criticism: the lathe bed, as universally employed, was really the most abused design for its purpose, also the V-groove construction on planing machines seemed to be entirely wrong.

Sir William Bailey, replying, said he was convinced that the exhibition would bring trade, and he therefore warned everyone to prepare by thoroughly overhauling their works, to be ready for a more prosperous time than they had ever had. In his firm, making fittings for boilers and engines, they felt the pulse of the trade all the time; when business generally was improving, millowners before ordering used up odds and ends to put their old plant in good order. They were doing this now with considerable determination, and before long would be wanting to replace old plant with new or extend to cope with business. Manchester was the home of all mechanical inventions, and all Joule's and Dalton's important discoveries. He contended, contrary to Ruskin, that civilisation was machine-made, right down from the flint age. Before Caxton's introduction of the printing press, Barcelona was the Cottonopolis of Europe, and he attributed the present position of England to the dissemination of knowledge which the printing press had made possible. This was the age of competition, and in his opinion, if a man had any ability at all, it would appear before he was 25. He, therefore, set the age limit in the competitions low. Many men dropped out because they failed to keep up-to-date, or to read the literature of their business. Distribution was civilisation, whether of books or of goods. The best engineer was the man who was fond of poetry. The engineer's work was creative, and he must develop the imagination and take an interest in life. Poetry was the greatest help to this.

Mr. Luke, the Director of the Exhibition, briefly proposed a vote of thanks to Sir William Bailey.

The Opening.

Sir W. H. Bailey was again in the chair, supported by the Lord Mayor, Mayor of Salford, and the other gentlemen present at the luncheon. Sir George Reid in opening the show expressed the same views on Imperialism as he had done at the lunch. It was his first visit to Manchester, but he was not ignorant of the enterprise which had always characterised Manchester men. The British people had been accustomed for centuries to occupy the foremost position and they did not intend to take another place. They must redouble their efforts, however—when one was last in a race, it required very little effort to catch up with one or two of those in front, but when one lead, the greatest effort was needed to maintain that position, for those behind were ever striving to pass to the front. The Mayor of Salford proposed a vote of thanks to Sir George Reid, being seconded by Mr. J. Morris, was carried with cheers. A vote of thanks to the chairman, Sir William Bailey, concluded the ceremony.

The Exhibits.

Preliminary Description.—The first thing which strikes one on entering the Exhibition Hall is the great diversity

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of lines shown. Each stand is occupied by a firm of standing, and mere stalls selling novelties, etc., are conspicuous by their absence.

Among the stands which will especially interest electrical engineers must be mentioned that of Ferranti. It is undoubtedly a very fine show. Here will be found an excellent line of motor starters of the open, semi-enclosed and totally enclosed types with fixed and free handle mechanism. Motor starting pillars and panels are also shown, while a motor speed regulating rheostat is shown in operation with an electrically driven machine tool. Another speciality is a regulator for lamps and fans. This is a resistance inserted in series with the load, and enables the amount of light emitted by a lamp to be as easily adjusted as is the case with a gas jet. There is also a very full line of automatic circuit breakers, time limit relays, switches, thermo time limits for switch gear and measuring instruments. The great thing on show here, however, is a H.T. 3-panel Iron-clad switchboard, fitted with oil break switches, meters, relays, etc., and intended for use by collieries or works taking a H.T. supply and transforming down on the premises.

We shall give a fuller illustrated description of some of these specialities later.

To the station engineer, probably the stand of the Lea Recorder Company will be the most attractive in the whole show. Here may be seen in full working a Lea patent combined indicating, recording and integrating instrument connected to a notch tank and arranged for measuring feed water. Everything is very plainly labelled; all the piping have direction arrows to show the flow of water. There are several other most interesting forms of the Lea meter, notch tanks and floats, etc. Also a special tank, etc., for dealing with acids. This meter is being highly recommended by all the leading engineers, and repeat orders, as well as new business, are crowding in to such an extent that the firm have now opened a London office.

A further illustrated description of this stand will appear in a later issue.

To the designer and manufacturer with an eye on the cost book, the stand of Aërators, Ltd., will appeal very strongly. Here are to be seen the famous "Prana" Die-finished castings. Thanks to the great experience which has now been obtained, there is now practically no limit to the multiplicity of parts which can be cast with the "Prana" plant. Many beautiful examples of their latest achievements are shown and no one interested in cheap production should miss an inspection of the stand.

Other "Prana" specialities are plaited metallic hose covering, constructed in a most ingenious manner, and adaptable for practically any purpose for which rubber hose is used. CO_2 Fire Extinguishers are also shown, in addition to a large assortment of other specialities, including sparklet syphons and bulbs, etc.

At the stand of William Boby may be seen some interesting water softening plant, and Fletcher's novel system of steam generation which saves the boilers and reduces costs.

Tangyes, Ltd., show a producer gas-plant working a 35 b.h.p. gas-engine set for electric lighting, and the engine has many special features.

The Morton Gas Syndicate, Ltd., have a producer (outside the building) working with common coal and driving a large engine. They also show a quantity of other plant including Bolton's super-heater.

At the stand of J. Marse & Company a variety of French machine tools are shown. The "Piat" hydro-electric rivetting machine, in which an electric motor drives through gearing, a ram which compresses the water and drives it to the cylinder operating the rivetter. It is a quick working machine and will close 350 rivets per hour for one unit. The water is used over and over again.

Royles, Ltd., show a variety of their well-known steam specialities, while much steam pipe work is to be seen at Edward Le Bas & Company's stand.

The Cambridge Scientific Instrument Company, Ltd., have a full working exhibit of pyrometers of all kinds, including the Féry radiation type. High temperature burners for laboratory use are shown, as also a sensitive high speed drilling machine for drilling holes from $\frac{1}{4}$ in. to $\frac{1}{100}$ in. in brass, gun-metal, etc. This is a very interesting tool and is shown working. Duddell Oscillographs are also shown.

The Drummond Bros.' exhibit of their well-known lathes should be missed by no one.

To every electrical engineer the stand of Sutcliffe (of Crumpsall), Ltd., will appeal, for here is to be seen the only British made fibre, which is turned out by the very large plant at Manchester.

To the boiler-house engineer, Messrs. Richard Klinger & Company's stand of improved gauge cocks, stuffing box packing, etc., and automatic lubricators will be specially interesting.

There is an unusually fine show of surface plates, etc., at the stand of "Crown Works," while at Henry Fels & Company there are many Johns one-stroke joist shears (all motor driven) which bite off lengths of huge steel joists with the greatest ease.

Jens Orten-Boving & Co., have a most interesting collection on view, including something quite new in engine governors.

At Estler Bros. much of interest to the storekeeper and factory organiser is to be seen.

Lassen & Hjort show water-softening plant at work.

The Eyre Smelting Company show their anti-friction metals, and a line of special interest to electrical engineers—"Bambers" non-crusting zincs for batteries, and a line of lamps fitted with the zinc for use in collieries, etc.

At Kelvin & James White's may be seen a new departure, a semi-automatic pattern-maker and universal wood-milling machine.

The Wardle Engineering Company show a full line of their "Streetlite," "Beatark" lines, as well as much apparatus for motor car lighting and the "Quatzalite" Bastian heaters.

Fastnut are doing good business with their well-known lines.

At Schäffer & Budenberg's a full line of pressure and vacuum gauges are to be seen, in addition to their valves, syphons, and other fittings.

W. H. Bailey & Company, Ltd., show a set (at work) of their "Davidson" patent independent boiler-feed pumps, 9½ in. diameter steam cylinders and 7 in. diameter pump cylinders by 24 in. stroke, and having quadruple steam valves and delivery valves. A Bailey "Koster" vertical two-stage air compressor direct coupled to electro-motor is supplying compressed air for driving the above line of pumps. A very fine selection of their well-known standard pressure recorders are exhibited, and also a number of Bailey "Fosters," reducing valves, and "Key Ring" steam stop valves for high-pressure steam. Other exhibits which are attracting attention here are the Bailey "Count Rumford" water heater for supplying boiling water for works, hotels, etc.; their patent "Bi-jet" accessible carburetter for oil engines and a large assortment of the engine and boiler mountings, exhaust cut-outs, speed indicators, and other specialities for which this firm is so well known.

James Aisey & Company show a very interesting exhibit which all steam engine makers or users should see. It is an improved form of packing ring, consisting of a solid ring with bronze rings on each side of it. These bronze rings expand in use and keep the cylinder steam tight against 210 lbs. or greater boiler pressure. No springs are required and thus wear and adjustment is obviated.

Messrs. C. E. Lugard & Company, St. John's House, Chester, show their "S.M." magnetic clutch driving a "Stirk" planing machine (capable of planing 8 ft. × 3 ft. × 3 ft.). The machine is driven by motor which runs continuously in one direction, the reversing being done through gearing by two electro-magnets, worked through a two-way switch actuated by the planer bed and adjustable to give any length of cut. The speed is automatically registered and is controlled through the motor shunt. Other specialities are the "Pillow" flexible clutch (shown in sizes from 7 h.p. to 300 h.p.) and the "S.M." drive applied to rolling mills, etc.

Several large General Electric Company motors are to be seen driving heavy boring mills, and large high-speed two-stage air compressors at the stand of Messrs. Tilghman's Patent Sandblast Company, and of Messrs. Geo. Richards & Company, Ltd., the tool makers.

There are numerous other stands which will be described in our next issues. To do the show properly would require about a week's close attention.

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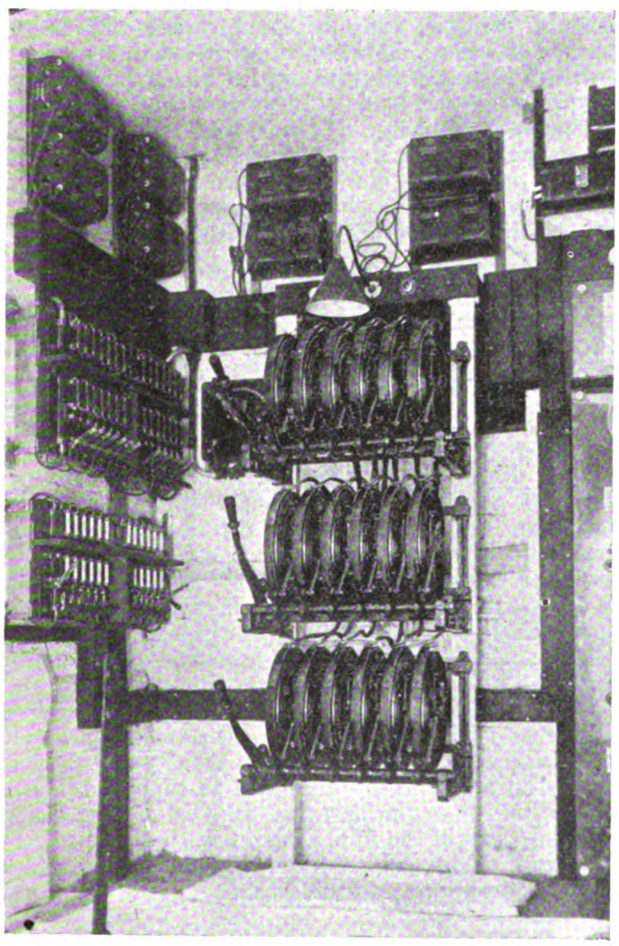
THEATRE DIMMERS.

All the theatre-going world is talking of the charming Little Theatre, John-street, Adelphi, and Mr. Laurence Houseman's not altogether adequate rendering of "Lysistrata." Certainly the house is a comfortable one, where details of all descriptions are carefully attended to. This is very noticeable in the matter of lighting. One of the excellent features is the installation of theatre dimmers. Our photographs show a bank of the Adams Manufacturing Company's "Simplicity" type of dimmers, as installed for Miss Gertrude Kingston at the Little Theatre.

It should be stated that the whole scheme of stage lighting and dimming was designed and carried out by Mr. W. E. Siday, electrician to Miss Kingston, and many new features to stage lighting have been introduced.

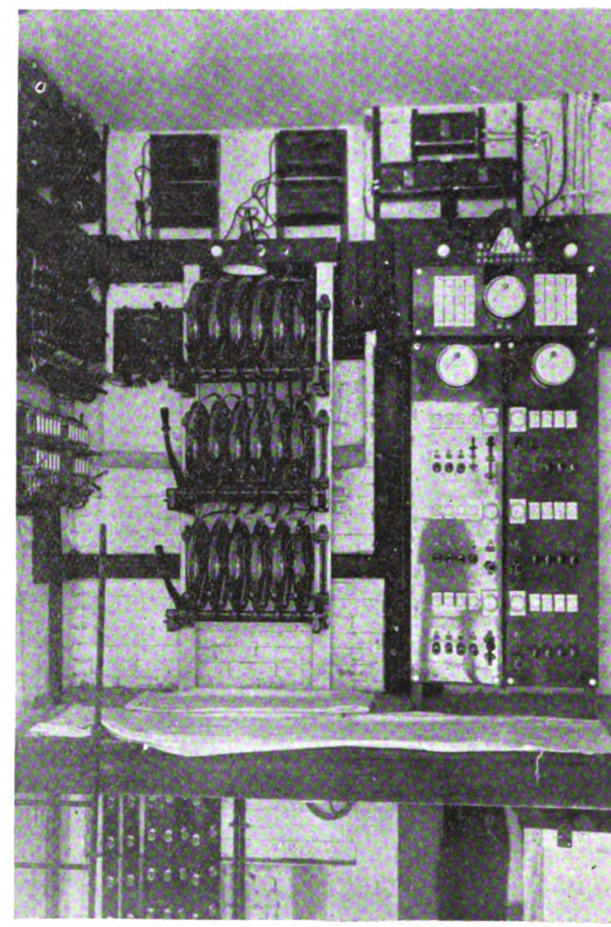
The switchboard is composed of the usual switches, but we believe this is the first time that the well-known Z.E.D. fuse has been utilised for theatre work.



As will be seen from the photographs, the switchboard presents a compact appearance. Owing to the very small amount of space which is available, it was necessary for the theatre electrician to look round for some more compact form of dimmer than the ordinary liquid type. After several tests he finally selected the "Adams" Manufacturing Company's "Simplicity" dimmer, as presenting many advantages in compactness and flexibility.

These dimmers are mounted up in banks and are operated by means of levers from the front. These levers are arranged with a very neat inter-locking movement, so that the whole bank can be operated by means of one master lever, if necessary. This interlocking is achieved by one half turn of the handle. The drive from the operating handle to the dimmer plate is by means of a rigid rod. The advantages of this over the old-time flexible cable drive or tracker wire, is at once apparent.

The other features are easy renewal of any faulty plate. Any one plate can be immediately withdrawn, and a new one inserted, without disturbing any other plate. It is possible, with this form of dimmer, to obtain an instantaneous flash—an effect which is quite impossible with the old form of liquid dimmer, with its acid pots and long length of tracker wire. Further, the stage electrician can work his dimmer on a long check, without any over-heating effects. Anyone who has endeavoured to do the same thing with the old liquid type must know the trouble and difficulty of keeping a steady light on check, owing to the boiling of the liquid. The installation is further note-



worthy inasmuch as mercury vapour lamps, have, for the first time, been successfully employed to give winter and night effects.

This installation has evidently pleased the critics, for, without exception, they mention the particularly clever lighting effects obtained at the "Little Theatre."

DIARY.

FRIDAY, OCTOBER 21.

INSTITUTION OF MECHANICAL ENGINEERS.—At the Institution, Westminster, at 8 p.m., Mr. Cyril Hitchcock on "The Standardization of Locomotives in India, 1910."

ELECTRO-HARMONIC SOCIETY.—In the King's Hall, Holborn Restaurant, at 8 p.m., The First Smoking Concert. In the chair, Mr. S. Z. de Ferranti, President I.E.E.

INSTITUTION OF ELECTRICAL ENGINEERS.—Glasgow Students' Local Section. At the Technical College at 8 p.m., First Meeting. Inaugural Address by Mr. H. A. Mavor.

MONDAY, OCTOBER 24.

LEEDS UNIVERSITY ENGINEERING SOCIETY.—Evolution of a Locomotive Machine Shop.

FRIDAY, OCTOBER 28.

INSTITUTION OF ELECTRICAL ENGINEERS.—Manchester Local Section. At the Physical Laboratory, Manchester University, at 7.30 p.m., Chairman's Inaugural Address by Mr. J. S. Peck, to be followed by Smoking Concert.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, South Kensington, at 5 p.m., Professor Ernest Wilson and Mr. W. H. Wilson, "Exhibition of a New Method for Producing High-Tension Discharges." Mr. F. Rogers, "The Behaviour of Steel under combined Static Stress and Shock," with exhibition of apparatus.

SATURDAY, OCTOBER 29.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Fleet-street, Social, "Ladies' Night."

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

As mentioned in my last week's notes, some reference to the subject of the Presidential address in last week's annual meeting of the Association of Mining Electrical Engineers may not be out of place, inasmuch as it is still a subject of discussion in mining circles. Briefly, the proposal is to improve the status of the members, particularly the younger ones, by instituting a practical and theoretical examination rewarded by a certificate. The chief difficulty, as shown at the meeting, is to define what a mining electrical engineer ought to know. Some of the members do not favour an examination at all; others want an easy one, made stiffer as time goes on, while the heroic ones want to begin as it is intended to continue, and only let the best men get a diploma. In order to give greater definition to the subject a sub-committee, including Dr. Thornton, of Armstrong College, is to draw up a model paper showing the type of questions they think advisable. Mr. Maurice, the president, appears to think that the syllabus of the City and Guilds of London Institute, plus a course of mining engineering up to the ordinary County Council standard, might meet the case; but I have heard the opinion expressed that as a mining engineer has to handle heavier electrical machinery than falls to the lot of the ordinary wire-man, the course of instruction required would be rather different to the City and Guilds course. It is, however, certain that last week's "Newcastle programme" is destined to be the subject of considerable discussion in the near future.

The Electrical Contractors in Newcastle.

Two subjects of considerable importance to electrical contractors were discussed at a recent meeting of the Newcastle branch of the Electrical Contractors' Association. One of these was the question of Municipal Trading. The Association is not at all in sympathy with the effort on the part of some municipalities to introduce a Parliamentary Bill for the purpose of facilitating the supply of electrical fittings and motors, wiring of premises, etc., by municipalities, and its opposition does not appear likely to be of a passive nature. At the meeting it was debated whether the best policy was for the claims of the electrical contractors to be placed before the public by the London Central Board, or whether each branch, knowing the local conditions better, could not more effectively draw attention in the right quarters. In connection with the pending bye-election at South Shields it was decided to get the views of each candidate upon the question under discussion.

The other matter referred to the practice which some manufacturing firms appear to have of quoting the same discounts direct to the general customer as they allow to the electrical contractor. One phase of this practice appeared to exist in connection with the "living picture" hall equipments. It was stated that some manufacturers of motors, switch gear, etc., would allow the owners of such halls to buy at as favourable prices as could be obtained by the contractor responsible for the wiring, and under such conditions the contractor had to connect up such apparatus to his installation and thereby take some of the onus of the subsequent running of the plant. The difficulty of the question, however, in the absence of sufficient organisation among contractors, prevented any decisive course of action from being adopted.

Tyneside Industries.

Some important developments in connection with Tyneside, some authenticated beyond doubt, others only rumoured, possess interest to the electrical fraternity. One of these consists of recent progress with regard to Messrs. Armstrong Whitworth's new shipyard at Walker, notes concerning which were given in a recent issue of these notes. Part of the land has to be leased from the River Tyne Commissioners, and one of the restrictive conditions pertaining to building on this land was that no property had to be built over a height of 8½ feet above the existing level of the ground. The excavation of the land proceeding at present gives more margin, but presumably not enough, so that the Commissioners have been asked to waive their restriction, and in view of the importance of the project it is probable that they will do so. Another matter which may probably open up chances for more electrical equipment, if rumours are correct, is that the Hebburn shipyard of Messrs. R. Stephenson, which has not been altogether successful recently, is to be amalgamated with Messrs. Palmers, of Jarrow. It is further suggested that the latter yards will thereupon be reserved for Admiralty work and the requirements of foreign Governments, mercantile work being done at Hebburn. If this is the case it is probable that somewhat extensive remodelling of the Jarrow yards will take place.

Tramway Developments.

Affairs in connection with the tramways of this area are still developing. The proposed extension of tramways through Hebburn is receiving the support of the Jarrow and Felling Councils, while the Gateshead and District Tramways Company are prepared to work the extended routes if the Hebburn Urban Council would construct them. The Newburn Urban District Council are prepared to consider the question of the extension of the Newcastle tramway system to Newburn in a favourable manner, subject to satisfactory terms, but they do not appear prepared to bear all the cost of the necessary road improvements, amounting to nearly £9,000. It is probable that the solution will be reached by their paying about one-third of the cost. The Newcastle Corporation Tramways Committee are busy drafting clauses which may be inserted in the next Corporation Bill to be promoted in Parliament. These bear reference to proposed tramway extensions already noted in these columns, and the provision of trackless trolley-cars, motor omnibuses, or other vehicles propelled by mechanical or electrical power in the city and specified extra-urban areas. They also wish to supply their own electrical energy in Newburn and the Castle Ward Union. Meanwhile some of the rural authorities, such as the Castle Ward and others, are apparently jibbing at trackless trolleys. Possibly on æsthetic grounds!

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The possibilities of the electric furnace in its applications to the steel industry were referred to on Saturday last at Dudley in the address of Mr. Walter Macfarlane, F.I.C., the new President of the Staffordshire Iron and Steel Institute. Electric furnaces, he said, promise to form an important addition to the equipment of some steelworks. A furnace in which a high temperature can be easily controlled and maintained without introducing an impurity into the furnace, and which in its operation does not tend to oxidise the products has, Mr. Macfarlane believes, much in its favour. It may be premature, he admits, to speak of its prospects for smelting purposes, though for refining, he believed it has ample scope. The Sheffield steelmakers, he says, appreciate the points in its favour, and its possibilities have not been overlooked by at least one Midland steel-making company. He has been informed that in Sheffield electric furnaces are making high class tool steel, and that electric furnaces are working in conjunction with open-hearth plants. Fluid dephosphorized metal is transferred to an electric furnace, and is there desulphurized,

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deoxidized and generally "degasified." In the preparation of useful ferro-alloys, the electric furnace, Mr. Macfarlane considers, must take a foremost place. It is, he says, the ideal furnace for the production of aluminium, and in aluminium there is present chemical energy sufficient to reduce any oxide (except magnesia) to the metallic state. The production of carbonless metals is, it is unnecessary to say, most important for certain purposes. Mr. J. W. Hall, in the course of the discussion on the President's address, expressed the belief that the great feature of further progress in the steel trade would be the application of electricity to the shaping and the heating of the bar and to the heating of the furnace.

Duralumin.

The discovery of the new alloy duralumin introduces, in Mr. Macfarlane's opinion, important electrical considerations. Duralumin contains over 90% of aluminium, in the extraction of which metal electricity is now the principal agent. The new alloy has so many desirable properties and so many possible applications that, in Mr. Macfarlane's opinion, it is bound to command an extensive field. Its present cost alone stands in the way of its general adoption. That cost, of course, would be greatly reduced if the supply of aluminium could be greatly increased and cheapened. In conversation with a correspondent of THE ELECTRICAL ENGINEER, Mr. Macfarlane said that Mr. J. E. Stead, the famous Middlesbrough metallurgist, had pointed out that Cleveland slag contains aluminium to the extent of one-seventh of its bulk. The slag is taken out in barges and dropped into the sea. This waste, Mr. Macfarlane remarked, is all the more remarkable from the fact that in the Cleveland district there is the means of generating an abundant supply of electricity by the cheapest method, namely, by utilising for the machinery the waste furnace gases. Mr. Macfarlane, therefore, sees in the increased demand for aluminium resulting from the invention of duralumin and similar alloys, the making of a new industry for the Cleveland district.

The Lord Mayor up a Chimney.

The completion of the second chimney stack of the Birmingham Corporation Central Power Station, Summer-lane, signalised last week by the laying of the topmost brick by the Lord Mayor (Alderman Bowater), calls attention to the rapid development of the electricity undertaking. The power station was opened four years ago with a capacity of 8,500 kw. The capacity has now increased to 19,000 kw., and the consumption of coal has increased from 445 tons to 1,250 tons per week. The output in units at the outset was 161,000. It is now 722,000. The stack is 230 ft. in height, and has an internal diameter of 15 ft., and is almost an exact replica of the first chimney, erected rather more than four years ago. These stacks are not quite the loftiest in the city, but, taking all dimensions into account, are by far the largest. Between half a million and three-quarters of a million bricks, making a total weight of about 2,750 tons, have been used in the foundation and stack of the new chimney, and the addition it means to the capacity of the works is equal to about 30,000 h.p. For several nights after the Lord Mayor's ascent, the crown of the chimney was illuminated with electric lamps.

Coming Extensions.

The extension of the Summer-lane works is by no means the end of the additions to the Corporation electric plant likely to take place within a few years. Last week the King's Norton District Council came to terms with the Corporation Boundaries Committee and consented not to oppose further the annexation of their district to the city. Among the conditions of the agreement is the taking over by the Corporation of the King's Norton Electric Supply Order. This brings within sight a considerable development of the Corporation's business, and a further extension of custom for electric power is expected from the Yardley district, which has already practically consented to come into the Greater Birmingham Scheme, and which, like King's Norton, has a large number of firms anxious to obtain a supply of electricity for manufacturing purposes. As the Borough of Aston has already agreed to annexation, together with the adjacent district of Erdington, it is safe to say that even should Handsworth ultimately be excluded from the scheme, the responsibilities of the Corporation in regard to electric supply will in the next three or four years be at least doubled.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

The great event of the district, in the engineering world, that took place during the week was, of course, the opening of the Engineering and Machinery Exhibition, full particulars of which are given elsewhere. The results up to now have given great promise that the show will very materially help those firms exhibiting to fill their works with orders. Trade generally in the district has been taking a very decided turn towards being really brisk, so that the show opens at the right moment. There are very few electrical firms with stands, but electric driving was very much in evidence in machine tools and motors and apparatus by most of the best known makers are to be seen in operation. A very interesting feature of the present exhibition is that a series of competitions have been arranged both for students and workmen visiting the show.

The Competitions.

Foremost among these must be mentioned the special prize consisting of a Dr. Joule Silver Medal, which has been offered by Sir W. H. Bailey for the best essay on "The Duties and Methods of an Ideal Foreman Engineering Pattern Maker." This must not exceed 500 words, and it is open to students, apprentices, workmen and foremen under 30 years of age to compete. The other competitions consist of (I.) a paper not exceeding 1,500 words, with or without pencil drawings, dealing with the exhibition generally; (II.) a paper not exceeding 1,000 words, with or without pencil drawings, describing any one stand; (III.) a paper not exceeding 1,000 words, with or without pencil drawings, but dealing with any one machine, appliance, or piece of apparatus shown. Three valuable prizes and diplomas, and a fourth diploma are offered for each competition. Entrance is free on forms provided, and papers must be sent in by October 31.

THE ELECTRICAL ENGINEER stand has been attracting much attention, and I should not be surprised if someone writes a paper describing it and dilating on the value of technical works. In addition, every Monday evening during the exhibition a special lecture will be given, followed by a general discussion. Altogether, the show is one which no one interested in engineering or machinery can afford to miss. The first of the series was delivered on Monday by Mr. Frank Nasmith on "The Electrical Engineer and the Textile Industry." Probably very few electrical engineers realised how great a field is waiting for them to develop. Unfortunately, the reading of the paper was not attended by anything like so large a number as the subject deserved. Those who spoke after the reading all agreed that it would be to the mutual benefit of the textile industry and to electrical engineers if this subject was more closely studied, and the hope was expressed that the paper would lead to a good discussion in the electrical and textile papers.

The next lecture is by Mr. A. T. J. Kersey, on the "Torque and Balancing of Internal Combustion Engines." The Annexe, it should be noted, is outside the hall, across the street to the right of the main entrance going in. Probably the difficulty of finding it has something to do with the poor attendance.

The Local I.E.E. Conversazione, another interesting function which took place this week, was the first Conversazione held by the Local Section of the I.E.E. at the Whitworth Institute. This proved a huge success in every way, and was attended by about 400 members and friends. The Chairman of the Section, Mr. J. S. Peck, and Mrs. Peck, Mr. S. Z. de Ferranti and Mrs. Ferranti received the guests. Among those present were Mr. C. K. Wordingham, the Electrical Adviser to the Admiralty, Mr. S. L. Pearce, Mr. and Mrs. S. T. Watson, Mr. and Mrs. W. Cramp, and many other well-known engineers. There is little doubt that a Conversazione will become an annual event here.

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SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

On Thursday, 6th inst., Professor Ernest Rutherford, of Manchester, visited Dundee and formally opened the Peters Electrical Engineering Laboratory, given to University College, Dundee, by Mrs. Garden and Miss Peters in memory of their late brother, Lord Dean of Guild Peters. Professor Rutherford referred to the connection between physics and electrical engineering, remarking that the exponents of the former had been in many cases the pioneers of the latter. When one considered Faraday's discovery in 1831, and looked at the development of electrical science which had taken place since then—telegraphy, telephony, radio-telegraphy, electric lighting and traction—there was reason to pause before questioning the practical utility of any scientific discovery. They could only say that a wider knowledge of the development of science would stop the query with regard to any scientific investigation: What is the use of it? Speaking of electric signalling, Prof. Rutherford said the naturally recalled the name of James Bowman Lindsay. Apart from his remarkable pioneer experiments in electric signalling without connecting wires, the speaker had been much struck by Mr. Lindsay's almost prophetic insight into the possibilities of the then infant science of electricity. He expressed the hope that the new laboratory would not only be devoted to the routine training of engineers, but by encouraging original research work among its teaching staff and its senior pupils, it would take its full share in extending their knowledge of electricity.

The laboratory is a two storey building. On the ground floor there is the battery room from which both the electrical engineering laboratory and the physics laboratory are supplied with low voltage currents; a high tension room in which the voltage supplied from an alternator in the dynamo room is transformed up to 1,000 volts; a research room and an alternating current laboratory. The dynamo room is a large one storey roof-lighted and side-lighted room at the back of this floor. On the upper floor there is a D.C. laboratory, a long photometric gallery and the lecturer's room fitted for research work. This excellent laboratory will undoubtedly fill a long-felt want in connection with electrical engineering in the north and eastern parts of Scotland.

Cambuslang Vacancy.

The post of Chief Engineer to the Cambuslang electricity undertaking is vacant, and for the moderate salary of £3 per week there are some 169 applicants.

Trade in the North.

Thanks to the excellent weather conditions which have prevailed in the North of Scotland this summer in conjunction with trade revival in other parts of the country, there have been exceptionally large numbers of visitors to the various Highland health resorts. The result is that electrical contractors are expecting to reap their share of the harvest in the shape of overhaul, renewal or extension of electric installations in the large hotels and hydropathics which are so plentifully dotted over the Scottish Highlands.

The Exhibition Boom.

We have not yet heard the last of the Glasgow Smoke Abatement Exhibition. Reports of its phenomenal success have been carried back to the various Scottish municipalities who sent representatives to visit it, and the spirit of emulation is undoubtedly abroad. At least three other Scottish Corporations may be expected to follow suit next year, and then no doubt Glasgow, flushed with the success of its last venture will come along in 1912 with something big. The advertising possibilities of an exhibition have spread to Ireland, and it is a fact that both the Belfast and the Dublin Corporations are contemplating an electrical exhibition each on its own in the near future.

Foreign Trade.

Apart from the home trade, which persists in being rather slow to come forward, it is gratifying to learn that several large supply houses, selling goods made South of the Border or elsewhere out of Scotland, as well as one or two of the Scottish manufacturing firms have recently received substantial orders both from the Continent and the Colonies. One well-known supply house last week shipped a large consignment of switchgear and fittings to India.

Technical Societies.

The various technical societies start in earnest with the winter's work next month. The Local Section of the Institution of Electrical Engineers are looking forward to a full session's work under the chairmanship of Mr. Sam Mavor, and the Students' Section, with Mr. H. A. Mavor as President, have also a number of interesting papers in view. The Scientific Society of the Technical College have issued an excellent programme, including several items of electrical interest.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The Siemens Halske A.G. has brought out a greatly improved form of connecting cords for telephone central stations. Experience has shown that cords break just where they issue from the plug. The improvement consists in wrapping that part of the cord with a short spiral of steel wire, whereby all sharp bending of the cord at that part is prevented, and whatever bending strain there is falls chiefly on the steel spiral. The spiral is slipped over the cord before it is inserted into the plug. This arrangement increases the life of the cord enormously and the same spiral can be used for the new cord.

Electricity in Turkey.

German electrical firms have received official intimation that the War Ministry of the Young Turks is about to work the military clothing factory at Ismid by electric power. All the persons contemplating getting the control should send a representative to Constantinople to consult with the Turkish authorities and prepare an estimate after studying the local conditions. The directorate of the Imperial Austrian Trade is in a position to name a reliable go between in Constantinople who will co-operate with such representatives.

Company Affairs.

The Allgemeine Lokal und Strassenbahn gesellschaft in Berlin has not done well during the last financial year owing to general trade depression in Germany. Nevertheless an improvement is now making itself visible. The company has sought to improve its position by purchasing other concerns, but during the year under notice, the only acquisition was the Lubeck Tramway in April, 1909. In the current year, however, the company has taken over the whole share capital (800,000 marks) of the Elektrizitats Werke Warnsdorf, which has a steam power driven station for supplying current to the town and environs. The company has also shared with the A. E. G. the re-organisation of the Silesian narrow gauge railways, taking over one quarter of the business. Finally, the company has acquired most of the shares in an electric and gas works at Wiborg in Finland, together with a 50 years' concession for a new electric tram and power station in that town in conjunction with the A. E. G. All these things are, of course, absent from the balance sheet, according to which the net profit for 1909 is 1,471,072, as against 1,463,818 marks for 1908–9. Of this sum 1,360,000 marks are devoted to paying an 8% dividend (the same as for last year) on the capital of 17 million marks.

The A. G. Brown Boverie & Cie, Mannheim, has issued a very bad report for the financial year ending March 31, 1910. Although the gross profits rose slightly from 2,453,256 to 2,566,878 marks, the net profit fell from 525,194 to 34,976, and the dividend will be only 4% instead of 6%. The expectations entertained in respect of the report year were not fulfilled as prices did not rise, and, in fact, fell in the case of some of the company's products, e.g., steam turbines. Increased competition and exactingness on the part of customers necessitated the employment of more hands. The first three months of the present financial year

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showed a turnover about 15% in excess of that in the corresponding period of 1908–9. In vew of the tendency to raising wages, better selling prices are urgently needed.

The Kabelwerk Rheydt is another instance of bad business. The gross profit fell in 1909–10 from 1,336,144 to 776,694, and the net profit (including carry over) from 351,863 to 10,614 marks, which will be carried over. The board complains of low selling prices and high buying prices. They cannot get money enough for their cables to meet the 80% rise which took place during the year in the cost of raw rubber. Attempts were made to raise prices by combinations of makers of insulated wires and cables during the winter, but came to nothing.

The following dividends have been declared. Deutsche Elektrizitats Werke zu Aachen, Gerbe, Lahmeyer & Company, 5%. Elektrizitats Aktiengesellschaft vorm. H. Poge, Chemnitz, 7%. Gesellschaft fur Elektrochemische Industrie Turgi (Aärau), 10%.

Electricity in Agriculture.

The "Schweizerische Elektrische Zeitung" has published some more interesting data referring to the employment of electric power on forms. These are best summarised in the form of tables.

CHAFF CUTTING MACHINES.

No. of knives.	Revolutions per minute.	Delivery of horse fodder per day.	Delivery of cattle fodder per day.	H.P. required.
2	160	300 kg.	600 kg.	3
2	150	600 ,,	1000 ,,	4
3—4	120—130	1200 ,,	2400 ,,	5

COARSE MILLS.

Roller length mm.	Revolutions per minute.	Output in hecto-litres per hour.	H.P. required.
150	500—600	1	1·5
300	,,	2	3·0
400	,,	3	4·0

The cost for current is about 2¼d. for 2 cwt.

VARIOUS MACHINES.

Sort of Machine.	r.p.m.	Output per hour.	H.P. required.
Milk separator	5600	2100l milk	1
Pasteurising apparatus ..	,,	200l cream	¼
Churn	,,	150 kg. butter	4½
Kneading machine ..	,,	—	¾

Arc Lamps for Photography.

M. Schrott has been making some experiments in the use of arc lamps for photography, particularly with reference to the relation between the actual illumination and the actinic power. Taking as unity the actinic power of an incandescent wire lamp, he has summarised his results in the following table, taken from the "Zeitschrift fur wissenschaftliche Photographie."

Source of Light.	Intensity of illumination.	Power required in watts per N.K.		Actinic Action after one hour's exposure at one metre distance		Ratio of chemical to illuminating power.
		without	with.	Chloride of silver Paper.	Yellow Pigment Paper.	
Wire lamp	40·25	1·2	1·2	0·414	—	1
Effect-carbon, red ..	1010	0·602	1·63	58·2	18·3	5·6
,, ,, yellow	1990	0·3	0·875	82·5	25·0	4·0
Ordinary arc lamp	2500	0·396	0·875	145	64·5	5·65
Effect-carbon bluish white	1990	0·291	0·845	320	6·1	16·5
Do. reddish white	2940	0·221	0·62	355	7·4	11·7
Ordinary mercury vapour lamp ..	765	0·34	0·57	53	3·3	6·7
Quartz mercury vapour lamp ..	1300	0·27	0·37	267	16·7	20·7

These figures show that the quartz lamp is the cheapest for photographic copying although its power is not fully developed until ten minutes after the current has been switched on.

Electricity in Iron Smelting.

The "Elektrotechnische Zeitschrift" has published some data showing how electricity has made iron pyrites as valuable a source of iron as even hematite itself. Iron pyrites is largely used as a source of sulphurous acid in oil of vitriol manufacture. The burnt residue contains from 46 to 57% of iron and 2% of unburnt sulphur. With proper fluxes nearly all of this iron can be got by means of the electric furnace, at a power-cost of 2,200 kw. hours. Where water power is used for current production the cost for getting one ton of iron is about 47 shillings, divided as follows:—

	s.	d.
Power	15	0
Coke (1,000 lb.)	7	0
Waste of electrodes (50 lb.)	6	0
Wages	4	0
Burnt pyrites (2 tons)	8	0
Flux	3	0
Repairs	4	0
	47	0

Under the same conditions it would cost 59s. per ton with the blast furnace.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The electrical trade of the United States is passing through the transition period common to this season of the year. The demand for heavy machinery always slackens with autumn, and the fact that no electric railway developments of first-rate importance are now in hand is also an important factor. There is, however, no diminution in the demand for small motors, which are being turned out in continually increasing numbers, while the lamp trade is busier than it has been at any previous period in its history. The introduction of the Mazda and other improved types of metal filament lamps, the recent developments in the manufacture of drawn tungsten wire, and the cheapening of the finished article, have all combined to give a tremendous impetus to the lamp trade. As the cold weather draws nearer there is a healthy demand also for all sorts of domestic appliances. A brisk business is being done in radiators and convectors, and also in electric flat irons, for which one New York firm has received an order this week for 30,000. The big incorporations report almost unanimously that business of all sorts has been of a record character during the first nine months of the year. The Western Electric Company, for instance, which employs 23,000 workpeople, has turned out 800,000 orders since the beginning of the year, each of an average value of upwards of $70. This company's total business for the whole year will, it is estimated, come out at more than $61,000,000, or about £12,500,000 sterling. The Westinghouse Air Brake Company report that their outturn for the nine months has broken all records, while the Allis-Chalmers Company has had the best season in its history.

New Electric Locomotive.

The General Electric Company, in conjunction with the American Locomotive Company, have just completed for the Brooklyn Rapid Transit system a new electric locomotive of the double wedge-ended type which presents some interesting new features. Designed for a weight of 55 tons, it is equipped with four General Electric commutating pole motors with a rating on the standard one-hour basis of 225 h.p., this type of motor having been specially chosen because of its eminently satisfactory behaviour under conditions involving great fluctuations of load and voltage, heavy tractive effort at starting, and high speed requirements on the level. At the one-hour rating the locomotive can exert a tractive effort of 16,880 lbs. at 20 m.p.h., and can maintain a tractive effort of 6,000 lbs. at 30 m.p.h. It is furnished with the Sprague type of control, which provides three combinations of motors, with a total of 18 steps, seven of the steps with all four motors in series, six steps with

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motors in series parallel, and five steps with all motors in parallel, the steps and the rheostat divisions having been proportioned with great care in relation to the weight of the locomotive. The range of control is well illustrated by the fact that with a current of 150 amps. from the trolley, the locomotive will develop a tractive effort of 6,500 lbs. on the first step of the controller, while on the series steps it will develop 27,500 lbs. with 450 amps. and will attain a speed of 7 m.p.h. with a 500-ton train. On the parallel steps the motors will require, approximately, four times these currents to develop the same tractive effort, but with the same train the locomotive will attain a maximum speed of 30 m.p.h. Third-rail shoes and trolley poles collect current either from a third rail or from overhead wires as demanded by the changes in the system between elevated and surface lines. There are eight driving wheels of 34 in. diameter.

The Prevention of Accidents.

Writing to the editor of the "Electric Railway Journal" on the subject of two recent collisions on electric railways in this country, Mr. Leland Adams, the Electrical Engineer of the South-Eastern Ohio Railway, Light and Power Company, puts forward the following plan for an emergency control of trains by the despatcher:

> A circuit controlled by a master selector, located in the dispatcher's office, is strung the entire length of the road. Each section of the trolley is to be controlled by a releasing device which actuates a heavy short-circuiting switch between the track and trolley. This device, operated by the selector, is installed at any convenient point on each section of trolley. When the dispatcher has issued a meeting order to two trains, he could set a semaphore against them at the meeting point as a further protection. If the crew of the train due first at the siding overlooks the orders or fails to see the semaphore the dispatcher will note that this train has not reported and is past due at the meeting point. Immediately he can start his emergency selector controlling the section or sections of the trolley on which the train may be running, and in an instant he has "killed" that section. He can then notify the sub-station operators handling the circuit breakers and take any other steps that are necessary to straighten matters out.

Such a plan, says Mr. Adams, could be made to fit the conditions on any road operated by a despatcher, while in cases where it is realized in time that a wrong order has been issued, the current could be cut off and the trains stopped.

Measurement of Wireless Waves.

In the current issue of the New York "Electrical World" Mr. George Seibt has an extremely interesting article on the development of the wave meter in wireless telegraphy. Mr. Seibt reviews the progress which has been made since the experiments of Hertz in 1886–87, the resonance phenomena then noted by him being the basis upon which all wave meters now in use are founded. The next step was the closed circuit devised by Lodge, the first device to replace the open oscillating circuit of Hertz, and then follows a review of the developments made by Thompson, Kirchhoff, Bjerkness, Tesla, Slaby, Scheller, Count Arco, Dr. Eichborn and others; and, finally, Mr. Seibt describes the instrument which he has himself designed for the Radio-Telephone Company, of this city. This instrument consists primarily of a closed oscillating circuit with a continuously adjustable capacity and a step-by-step adjustable inductance, the additions made to the oscillating circuit being dependent upon the specific use to which the instrument is to be put. Three three-wire inductance coils, wound upon hard rubber cores, give three overlapping ranges of measurement of wave lengths, namely, 200 to 600, 450 to 1,300 and 1,000 to 3,000. Of the two detectors, one is a standard Radion detector, consisting of a thin, adjustable brass contact point and a lead sulphate crystal as a second electrode; and the other is made up of a thin platinum wire fastened on one side to two lead sulphate crystals, and on the others between two brass plates. The crystals are covered with a coating of paraffin to avert oxygenation. Mr. Seibt claims for his instrument that when constructed as a calibrated resonator it has a sensitiveness such as has hitherto never been known and can, therefore, be used for observing the powerful waves of the sending station as well as the incoming waves. In the erection of a station this instrument can be used to tune the antennæ and the primary oscillation circuit to the desired wave length, while when used as a calibrated sender it serves the purpose of tuning the receiving apparatus to the determined wave-length. On completion of the station, it serves as a control of sender and receiver, and finally in the laboratory it is suited to the investigation of electrical properties of oscillation systems, for the taking of resonance curves, and for the determination of the degree of coupling and the damping co-efficient of circuits.

Electricity and the Airship.

As the Wellman-Vaniman dirigible airship "America" may possibly be on her way across the Atlantic by the time these Notes are printed in the ELECTRICAL ENGINEER, a description, from an authoritaive source, of her electrical equipment may prove both timely and interesting. This was designed and fitted by Mr. B. B. Whelan, of the Buckeye Electric Company, and consists of a quarter-kilowatt shunt-wound, 10 amp. d.c. Hawthorne generator running at 1,500 r.p.m., a 12-cell storage battery, a three-station automatic telephone set, and eight 20-volt 25-watt tungsten lamps in Holophane steel reflectors. A special wireless outfit with a range of 75 miles has been installed by Mr. J. R. Irwin, of the Marconi Company. As the steel frame of the airship constitutes the aerial of the Marconi outfit, Mr. Whelan was confronted at the outset with a formidable problem in connection with effective insulation. To overcome this difficulty a special conductor was manufactured in the shape of No. 8 gauge stranded copper wire covered first with fine asbestos and then with rubber solidified to a coating one-eight of an inch thick. This wire was subsequently spun with jute to give adequate tensile strength, and the strands were then woven, encased in fabric, and treated with a fireproof solution. On puncture test this insulation was found able to withstand 26,000 volts between terminals. A second problem was that of devising a method of dealing with such an emergency as the stoppage of any of the three engines with which the airship is equipped. This was effected by building a frame at each engine, fitted with pulleys and belt, multiple cable being run from the forward to the after engine and a double throw switch installed. The wireless apparatus is operated in multiple with the lamps, the circuit being so devised that should the battery fail, both the wireless apparatus and the lamps can be operated directly from the generator. The airship has a total length of 228 ft., has a lifting power of a little over 1 ton 1 cwt., and is propelled by two 80 h.p. gasolene motors. There is also a 10 h.p. service engine to operate the air-pump which prevents the balloon from getting deflated and also to work the winches for handling material between the frame-work of the airship and the lifeboat which, with the Marconi apparatus inside it, is suspended beneath the frame-work.

ROYAL NAVY ELECTRICIANS.

The Admiralty officially notifies that a poster of electricians who have passed for chief electricians is to be established at each port, and candidates are to be placed on it in order of passing. Electricians who desire to pas for chief are to be examined before requalifying in the schools. 70% of the marks in any one subject, or 75% in the aggregate, are required in order to pass. Candidates who fail to obtain the requisite percentage may, on the recommendation of the torpedo school, be allowed to present themselves for re-examination in three or six months, a second rejection being final.

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TRAM-CAR METERS.

Practical results attained in England, on the Continent and in America by the installation of meters on cars induces a feeling that we have found here a universal aid to economy in tramway working. But as the German and French reporters at the Brussels International Congress showed, much investigation still remains to be done as to the merits and characteristics of the various meters. The truth seems to be that so far no one meter can be looked upon as the best for universal application, much depending upon not only the system of electrification adopted, but the mechanical arrangements and, to some extent, the character of the traffic. For example, the London County Council have been rebuked for not having placed meters on a great number of cars. As a matter of fact, however, trials have been made, and the experiments had to be abandoned, because, as a member of the Tramways and Light Railways Association points out in the official transactions, certain features of permanent way and of traffic management peculiar to London made the older forms of meters inapplicable. In London we have both overhead and conduit systems, and a very large number of the cars have to change over from one to the other. It was found that cars on the conduit system are liable to reversal of polarity on crossing a section insulator. It, therefore, meant that each car would have to be provided with two meters; cost and complication in working rendered this solution impossible. Fresh trials, however, are, it is understood, to be made with the mercury type of ampere-hour meter. It is hoped that this instrument will register accurately on both systems, and in spite of reversal of polarity. The member of the Tramway Association referred to above makes certain practical suggestions which are worthy of consideration by manufacturers, and may point out to engineers certain lines for further observation and investigation. The critic is of opinion that we should have

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a meter which records actual energy-consumption. Harping upon the difficulties of London service, where an average high-speed schedule is the rule, where the areas vary tremendously in the load, and which, moreover, are fed from 23 sub-stations, bringing about unavoidable differences of pressure, it is inevitable that inaccurate recording should result from the use of the meters hitherto most commonly adopted. Pressure may vary as much as 50 volts on different sections; therefore the difficulties of calibration render accuracy, say, within 10%, quite out of the question. For a meter to record now minus now plus up to 10% can scarcely be said to serve its intended purpose. It is, therefore, held that manufacturers should turn their attention to the development of an integrating watt-hour meter free from the troubles inherent in the traction watt-hour meters so far introduced. But, as we have said, the ideal seems to be an energy consumption recorder. Difficulties, as we know, are made to be overcome. Here and there the pecularities of given systems will give trouble in the attempt to measure the energy expended in running a tram service, but this only means that more research is needed. The fundamental fact that the use of meters does lead to economy and better running is abundantly proved. It is now a matter of perfecting, if not a universal meter, then several types, each suitable for different conditions of running. It is clear, however, that the meter, by saving expenses of working, is one of the potent factors which will make tramway extension into thinly populated districts possible, but this being so, it is clear that a meter accurately sensitive to variations in pressure, and indifferent to changes of polarity is absolutely necessary.

CATALOGUES AND PRICE LISTS.

Among the catalogues and price lists recently received are the following:—

Messrs. Siemens Bros. & Company, Ltd.: Very full list of "Vulcanized India-Rubber, Wires and Cables."

The General Electric Company, Ltd.: "Country House Lighting."

The Witton-Kramer Electric Tool & Hoist Company: List K18, fully illustrated, deals with electric hoisting and transporting specialities.

Union Electric Company, Ltd.: (1) Small 8-page pamphlet, "Instructions for Starting, Cleaning and Maintaining Direct Current Dynamos and Motors." (2) Illustrated price list of "Union" D.C. motors.

S. Heilpern: Illustrated price list, Accumulator Sediment Pump, "Unica."

Walsall Electrical Company, Ltd.: Catalogue of Meters for D.C. and A.C. for switchboard, testing and portable use.

Elliott Bros.: Illustrated price list of Moving Coil Instruments, Type N.

Herbert Morris & Bastert, Ltd.: Illustrated pamphlet of worm-gear pulley-block.

British Manzel Oil Pump Company: Pamphlet, "Patent Automatic Force and Light Feed Oil Pumps for Cylinder Lubrication."

The Benjamin Electric, Ltd.: Pamphlet on "Benjamin Wireless Clasters and Electric Lighting Specialities," with space for dealer's or contractor's name and address to be printed on cover.

Davies & Metcalfe, Ltd.: "Injectors" for hot water, live steam, exhaust steam; also water lifters, valves, etc.

Wm. Geipel & Company: "Motor Starters, Resistances and Rheostats."

Crompton & Company, Ltd.: Pamphlet D. 26, "Enclosed Motors and Dynamos, Continuous Current."

Jens Orten-Böving Company: Illustrated pamphlet, "Flexible Insulating Coupling, Zdel-Virth Patent."

The Dowsing Radiant Heat Company, Ltd.: (1) Illustrated Price List, 1910–11 Session, "Luminous Electric Radiators"; (2) "The Solarium, or Electric Sun Bath."

W. T. Glover & Company, Ltd.: (1) "The Prevention of Fatal Accidents in Mines"; (2) Light Type Cable Suspenders.

FINANCIAL NOTES.

MEXICO TRAMWAYS.—The directors of the Mexico Tramways Company have declared a dividend of 1¾ per cent. for the quarter to September 30 on the issued capital stock of the company.

* * *

CITY OF BIRMINGHAM TRAMS.—The directors of the City of Birmingham Tramways Company, Ltd., have declared an interim dividend at the rate of 10 per cent. per annum on the Ordinary shares for the nine months to September 30.

* * *

NEW ST. HELENS AND DISTRICT TRAMS.—The directors of the New St. Helens and District Tramways Company, Ltd., have declared a dividend of 1½ per cent. (1s. 6d. per share) on the Preference shares on account of arrears.

* * *

MUREX MAGNETIC COMPANY.—The directors, reporting for the period April 15, 1909, to June 30, 1910, state that no opposition has been taken to the granting of the patents in any country. The unit at work on the Cordoba Mines has obtained excellent results, and a second unit has been sent out for erection. Great delay occurred in the erection of the plant at Broken Hill, but the engineer now at Broken Hill is satisfied that it will run successfully. Official trials for various mining companies have been conducted at the works during the year, with gratifying results, and certain contracts have been concluded and others are under negotiation. Experimental work effected during the year has considerably widened the scope of the invention.

* * *

MANILA ELECTRIC RAILROAD AND LIGHTING.—The gross earnings of the Manila Electric Railroad and Lighting Corporation for the year ended December 31, 1909, were $1,141,689, as compared with $1,127,341 in 1908. Operating expenses were $600,570, against $576,849, leaving net earnings of $541,119, as compared with $550,492. Fixed charges (including sinking fund) absorb $300,005, and the consequent surplus is $241,024, as against $252,185 for the preceding year. The net earnings for 1910 to September 30 are $474,597, showing an increase of $102,306.

* * *

NORWICH ELECTRIC TRAMS.—The net profit for the year was £8,377. A dividend of 1¼ per cent. is announced, and a sum of £307 is carried forward.

PERSONAL.

Mr. H. A. Decourcy-Browne has resigned his position in the New South Wales Tramway Traffic Branch to take up the post of Traffic Manager of the Christchurch Municipal Electric Tramways, Christchurch, New Zealand.

Mr. R. J. Browne, M.I.E.E., has been confirmed in his post as Electrical Inspector for Bengal, Eastern Bengal and Assam. The salary attaching to the permanent post is to be 600 rupees, rising to 1,000 rupees per mensum. But Mr. Browne commences at the full salary, with a personal allowance of 100 rupees per mensum in recognition of his long Government service.

Mr. J. N. Bailey, of the British Westinghouse Electric and Manufacturing Company, Ltd., has been awarded, by the Manchester Association of Engineers, the Constantine Gold Medal for the best paper read during the year. Mr. Bailey's paper, which was read during the Session 1909–10 was entitled "The Exhaust Steam Turbine."

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TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

QUESTIONS.

Question No. 1232.—What is the most modern practice of arc lighting where the lighting is scattered over a very large area with long distances between each lamp as for dock or railway lighting; a number of 50 lamps being so placed that they would cover a length of run of some six miles from and to generating station? In considering the question, the lighting is to be so arranged that any lamp can be switched on or off as required according to the work going on in the locality, with a corresponding saving in power on switching off; and also provision to be made for installing any further new lamps at any point. Discuss the alternatives considering the capital cost and running charges of the long series constant direct current system with its single run of cable and low generating efficiency, and the short series parallel system across, say, 440 volts, and the long series alternating system with constant current transformer. Providing the long series constant current system gives the most advantage in efficiency, cost, flexibility and general lighting, what is the most efficient way of generating the current, the most modern dynamo, and how to be driven, seeing the small kilowatt capacity of the unit.—"E. J. P."

ANSWERS.

Question No. 1227.—What type of motor is best for metal shears? Compare A.C. and D.C. machines and state what horse-power is required for a given duty and how the power is dissipated between the various resistances. How does the horse-power vary during the cycle, and how does the length of cycle affect matters? Is there any reliable relationship between the area of metal cut and the power required, and what flywheel capacity is required? Also how is the latter determined?

Reply to Question No. 1227 (*awarded* 10s.).—*Motors*: Pure shunt-wound motors are, of course, out of the question for shear driving: their speed being constant at all loads to within 5%–6%, no sufficient advantage could be taken of any practicable flywheel to bring the motor load fluctuations within reasonable limits. Pure series wound machines are equally unsuitable in most cases by reason of their dangerously high "light" or "friction" load speed; in such cases the friction load, though = 20% (small sets)—25% or 30% (large sets) of the total cutting load, is insufficient to prevent excessive speed variation from light—full load of the motor. It therefore follows that, when D.C. motors are employed for shear driving, compound wound machines are used. These motors have a high overload capacity for a given continuous rating, and are robust mechanically and electrically, but (as shown later) it is desirable to compound more heavily (30%–50%) than in standard A.C. compound motors (15%).

Where A.C. motors are employed, the squirrel cage induction type is usually chosen; unless the motor has to be started and stopped very frequently, the wound rotor, with its attendant increased complexity, should be avoided. Fairly high resistance end rings giving, say, a maximum slip of 15% if for intermittent work, or 10% if for continuous running, will secure a sufficiently high starting torque at a sacrifice of some 4% of the full load efficiency otherwise obtainable. The speed, load and efficiency characteristics of such a machine would be very similar to those of the D.C. motor which would be applied to the case.

On the whole, D.C. motors are preferable to A.C. machines for shear service, though the latter have been considerably adopted for this duty. A.C. machines will, in general, need a heavier flywheel (and hence more gradual starting and heavier starting gear) than A.C. motors on the same load. For, whereas 15% is the maximum desirable slip for A.C. machines, D.C. motors can be 50% compounded, and hence work with a very steep speed load curve and moderate flywheel inertia. Where many A.C. motors are used, it is good practice to start up from one or more central auto-transformers (giving, say, 65% line voltage, and hence 0·42 × torque obtained and main current taken when starting on full line pressure), rather than to install an auto-transformer for each motor. The starting demand may be three times the maximum cutting load.

TABLE I.—MOTORS AND FLYWHEELS FOR VARIOUS SHEARING LOADS.

Weight flywheel. lbs.	Energy at full speed.	Motor H.P.	Compounding.	Friction Load.	Total Cutting Load.	Section Cut.	Material Cut.	No. sections cut by flywheel energy.
	h.p secs.							
20,000	2,500	50 h.p.	50%	11·8 kw.	25·9 kw.	$7\frac{1}{2}$" sq.	Hot Steel	4
12,700	5,900	125 h.p.	25%	22·5 kw.	45·0 kw.	$8\frac{1}{2}$" × $7\frac{1}{4}$"	,,	4
3,000*	—	60 h.p.	15%	—	10·4 kw.	4" sq.	,,	3
8,760	3,890	60 h.p.	$11\frac{1}{2}$%	—	67·5 kw.	—	—	—

* In this case the flywheel capacity was found to be insufficient.

Load: The nature of the section sheared, even assuming the same material throughout, has, of course, considerable effect on the horse-power of motor required. Thus, whereas *plates* are cut gradually, the maximum cutting load persisting perhaps for 10 seconds or more, followed by an "off" period of 50 seconds or so during which the flywheel can regain its lost energy, *blooms* and similar nearly square sections are cut practically instantaneously; the cutting stroke may be 1 to 3 seconds in such cases, the recuperative period being 5–10 seconds. In other instances the cutting period is even shorter, so that obviously all speed variations of the motor, and with it the flywheel, must be truly inherent and not effected by hand or automatic regulation of external conditions at the moment of application of the load.

The desideratum of a shearing plant is that the flywheel should take the whole of the peak of the cutting load, the motor running at as nearly as possible constant speed and load and restoring the "peak" energy to the retarded flywheel during the non-cutting periods. The longer the "off" period, the lower the motor horse-power required to restore a given amount of energy to the flywheel; the longer the cutting period and the shorter the recuperative period, the higher the motor horse-power required (assuming that during the longer period proportionately more metal is cut). It is impossible to give any very definite relationship between the area of metal cut and horse-power of motor required; but the data of Table I. illustrate the working of certain vertical bloom shears. Incidentally, the relative magnitude of the friction and cutting loads is shown, as well as the flywheel capacity provided in the several cases. The flywheel inertia should be such that three or four sections could be sheared by its stored energy

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alone (*i.e.*, with the motor circuit broken and the set initially running at full speed).

The inertia of a uniform disc flywheel of weight *W* lbs. and diameter *a* ft. is:

$$I = \frac{W}{8g} . a^2 \text{ ft., lb. units.}$$

If the whole weight can be considered concentrated in the rim at radius *r* feet:—

$$I = \frac{W}{g} . r^2 \text{ ft., lb. units.}$$

Current and Speed Characteristics of Working Cycle.—The general form of these characteristic curves is shown in Fig. 1. It is desirable that the motor current at the end of the "off" period should just have fallen to its friction load value. Let the flywheel storage capacity be H h.p. secs., of which $\frac{1}{n}$th is evolved during the cutting period then, during the "off" period, a certain mean current *A* amps. must be taken by the motor, in addition to the friction load current, to restore $\frac{H}{n}$ h.p. secs. to the flywheel. If these conditions be fulfilled, the motor current will clearly vary from F to (F + 2A) amps. (Fig. 1), the speed-time curve being somewhat as shown. From the points XY, whose co-ordinates are known, two points on the motor speed-load curve can be at once fixed and a machine with suitable speed characteristics rapidly selected. In most cases from 30%–50% speed variation from "frictional" to "full" load is desirable, but in cases where A.C. is used 15% is the limit (squirrel cage machines). From a current-time curve constructed as above, the R.M.S. current during the cycle can be easily determined, and thus a motor of suitable cooling capacity provided. It is desirable that the motor should need only a slight increase in load to give the necessary speed drop to enable the flywheel to deal with the cutting load; it therefore follows that *the steeper the speed-load curve of the motor* (*i.e.*, the stronger the compounding), *the smoother will be its load curve.*

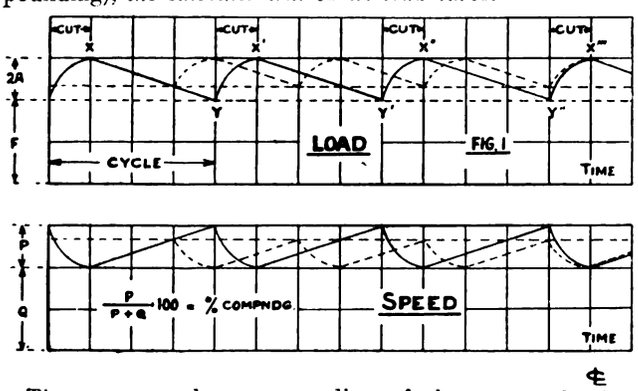

FIG. 1

The stronger the compounding of the motor the less variation of load will give the required flywheel speed variation, and, therefore, the lower the peak current X (Fig. 1); and hence, for a given time cycle and constant friction load, the more gradual the current decrease during the recuperative period. Reduced compounding results in a flatter speed curve (Fig. 1), but a more fluctuating load curve.

If a fresh cut be commenced before the recuperation from the last cut is complete, it is clear that the current never reaches its friction load value; the R.M.S. current increases and the motor rating must be increased; the speed curve and load curve will both be flattened as dotted (Fig. 1). Increasing the flywheel capacity reduces the speed variation necessary for a given output of energy from the wheel, and thus, for a given motor, still further smooths its speed and load curves. Increasing the compounding of a motor may enable a smoother load curve to be obtained even when employing a lighter flywheel (the speed variations will, of course, be greater in the latter case). To obtain a uniform load curve and a reasonably constant speed, a motor with a steep speed-load curve and fitted with a heavy flywheel, should be used.—"L. C."

The dirigible air-ship "America," in which Mr. Wellman sailed so gallantly from New York and came to so untimely an end, besides being equipped with a wireless telegraphic installation, was lighted by electricity, the lamps being fitted with Holophane steel reflectors throughout.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (Incorporated.)

The committee of this association a short time back decided that in future in addition to the ordinary annual general meeting of the association, half-yearly meeting should be held, and that these should preferably be held in towns other than London where the annual general meeting has to be held. The first half-yearly general meeting was held at the Midland Hotel, Manchester.

The first matter taken was the amended articles of association. It has been felt for some time by nearly all the members that the old articles of association did not confine the management of the association sufficiently to British manufacturers, and Mr. Butler, of the Electrical Power Storage Company, Ltd., who was elected to take the chair, pointed out to the meeting the somewhat drastic alterations which had been made in the new articles of association, and proposed a resolution in favour of their being passed, which was duly carried, as was the second resolution put by the chairman for the purpose of empowering the committee to re-classify the existing members as soon as the new articles come into force.

Manufacturing sections consisting of members of the association who manufacture similar goods have recently been formed, and many points were decided on as to the constitution and management of such sections, the main object being the bringing together of competing manufacturers for the purpose of getting matters of common interest settled, and it was generally anticipated that much good work will be done by these sections.

A resolution was passed regarding the desirability of joint action in view of the great increase in the number of exhibitions, which are now being promoted, and this resolution, together with one relating to the formation of a co-operative exhibit by members of the association at the Turin Exhibition, was agreed to.

The last item on the agenda related to the action of certain municipalities who, not content with merely using their shops as repairing shops, were doing a certain amount of manufacturing. In view of this it is very desirable that the association should have a distinct policy on this subject, and a resolution was passed to the effect that extended powers for manufacturing and trading purposes should not be granted to local authorities.

The result of the recent more active work of the association is a great increase in its strength, for not only has the membership nearly doubled itself, in the last 12 months, but most of the new members being large firms, the capital represented by the members of the association is now some three or four times that which it was.

THE QUARTZLITE LAMP.

The Brush Electrical Engineering Company, who have already given us the popular "Metallum" and excellent types of flame arc and enclosed arc lamps, have added to their triumphs the Brush "Quartzlite" lamp. This, at all events at the present stage, is intended for outdoor use and for illuminating extensive premises. No carbons or filaments are used, the burner consisting of a quartz tube, enclosing a small amount of mercury. When the electric current passes through the tube, a brilliant light of intensely penetrating properties is produced. The colour of the light makes it unfit for lighting private apartments and shops, but otherwise it marks a distinct advance in the science of illumination. The manufacturers claim that on a 100 volt circuit the standard lamp gives 1,800 c.p. per hour at the cost of one-third of a unit; or on a 200 volt circuit, 3,000 c.p. per hour at a cost of two-thirds of a unit. It will burn without renewal for 2,000 hours. According to the laboratory tests of "The Lancet," the Brush "Quartzlite" has distinct hygienic qualities. Of its success for certain phases of public lighting and industrial purposes there can be no doubt whatever. The lamp is of reasonable size, and fairly presentable in design, the globe being of bowl pattern.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

BATH.—Steps are being taken to form a branch of the Electrical Trades Union here.

DONAGHADEE.—The Urban Council have instructed their clerk to prepare a memorial for obtaining a Provisional Order within the Electric Lighting Act, to be presented at a Council meeting on the 15th ult., and to give the necessary notices. Meanwhile, Messrs. T. L. Miller, Wilson & Pegg, of Belfast, and Wilkins & Burden, of Dublin, have been asked to submit electric lighting schemes and estimates of cost.

DUNDEE.—Mr. H. Richardson, borough electrical engineer, reports that the cost of production has been reduced from £86 per 1,000 units sold in 1909 to £46 per 1,000 units this year.

DUNDEE.—At a speically called meeting on Friday last the Dundee Town Council resolved to support the Incorporated Municipal Electric Association in their forthcoming Bill with regard to Municipal powers for motor hiring, as suggested by the engineer. As evidence of electrical progress, it may be mentioned that 700 electric lights are being installed on common stairs throughout the city. Messrs. Joseph Allan & Sons, coal merchants, etc., have adopted electric power in place of steam, and Lochee United Free Church was lit up by electricity last week.

GRAVESEND.—The Town Council decided to distribute the available balance from the electricity undertaking as follows: To capital account £642 1s. 11½d., to local rates to meet corresponding deficit on Northfleet undertaking £262 10s. 2¾d., to be carried forward £38 18s. 11½d., total £943 11s. 1½d. Mr. C. F. McInnes, the electrical engineer, in his report, points out that the gross profit, £4,779, is higher than in any former year, being £90 more than the year ending March, 1909. The net surplus, after paying interest and loan repayments, is £512, as against £418 in the year previous. In considering these figures it should not be forgotten that they have been obtained in the face of a reduced revenue from the tramway company of £379, and an increase in costs due to litigation of £146, these amounts affecting a comparison between the two years to the extent of £525, and that adversely to the year now completed.

GREYSTONES, IRELAND.—The Rathdown No. 2 Rural Council have decided to waive all rights to notices so as to facilitate the Greystones Electric Lighting Company obtaining their Provisional Order.

LLANGOLLEN.—The financial differences between the Urban Council and the Electric Lighting Company, chiefly in connection with the laying of mains, are to be submitted to arbitration, and the Surveyor, Mr. Gray Owen, has been instructed to prepare the Council's case.

MANCHESTER.—The Waterworks Committee are considering tenders for the electric light installation at their pumping station, Whitworth-street, West.

NEWPORT, MONMOUTH.—An interesting point was raised at a Council meeting, when a protest was made at selling machinery which had cost £10,000 to a dealer for £953. It was argued that the sale had not been advertised sufficiently. The excuse was that it had been advertised twice and that the plant had to be moved quickly to make room for new machinery. The drop in price, however, is enormous, and appears to justify the contention that the advertising had been inadequate.

NORWICH.—In view of the approaching expiry of the existing contract between the Corporation and the British Gas Light Company, Ltd., it is proposed that by next October streets in a given area should be taken over and electricity substituted for gas—the first instalment will be 754 lamps. If this proves satisfactory a further area would be taken over in 1912 and the remainder in 1913.

ORKNEYS.—Wireless telegraph stations have been established on two of the islands: Sanday and North Ronaldshay.

STAFFORD.—The Corporation are advertising for an engineer and manager to take entire charge of the gas department and supervise the electricity department. The salary is £350, to be increased to £500 by annual instalments of £25. Candidates must be between 28 and 45 years of age, and must send in applications on or before Monday, October 24, to the Town Clerk.

TRURO.—Definite terms have now been agreed to between the Town Council and Messrs. J. and W. Purves. The latter are to promote a Bill in Parliament and will pay the fees of a Parliamentary Agent to be appointed by the Council to watch their interests. The periods at which the Council may purchase the undertaking have been altered from 15, 22, 29, and 36 years to 14, 21, 28 and 35 years, and the period of notice reduced from 12 to 6 months. The price to be paid will be for the undertaking as a going concern, but without allowance for compulsory purchase. A long list of streets in which mains are to be laid within two years of the Provisional Order being obtained, has been agreed to.

WAKEFIELD.—At a meeting of the Wakefield Council, Mr. Greaves (chairman of the Electric Lighting Committee), calling attention to the report of the electrical engineer, said that the public ought to know that the electric undertaking was not in that parlous state which might be supposed. He mentioned that although there had been a loss of £800 during the past year, this was entirely due to the introduction of metallic filament lamps, which had in many instances effected a saving to the consumers of 50%. By raising the price from 4d. to 4½d. a unit, it was believed the undertaking would be a paying concern.

WORTHING.—The Council's electricity revenue shows a persistent fall owing to the general adoption of metallic filament lamps. As a temporary expedient, it has been decided to drop contributions to the depreciation fund this year, and thus avoid a deficit or the need to raise the price of current.

OVERSEAS.

BUENOS AYRES.—The tender of Messrs. Casella & Salvetti for an electric light station at Maipu (Province Buenos Aires) has been accepted. Government has been authorised to carry out surveys for a general telephone system throughout the Republic and to spend the sum of $50,000 thereon.

FORT SASKATCHEWAN.—The hydro-electric project undertaken by this Municipality is progressing. It is expected that the dam will be completed by the end of December, and if machinery is delivered, the power house will be equipped and deliver power before next spring. The dam is situated a mile-and-a-half up the Sturgeon River from the point where it empties into the Saskatchewan, five miles below the town. The amount of power which will be developed is estimated at 300 h.p. per annum. The cost of the work has been figured at $35,000, which includes the purchase price of the land. As this is the first municipally-undertaken power project in Alberta, the success accompanying it will be watched with interest.

SANTA FE.—The Municipality have accepted the tender of L. P. Winby & Company for electric tramways. The principal points of the concession are: Period 65 years, construction of 28 kilometres of line, purchase of the actual Municipal horse tramway for $160,000. Work to be completed in three years. Tariff for electric light 35 cents the kilowatt. At the end of the concession the line reverts to the Municipality.

TORONTO.—The City Council have given the Montreal Light, Heat and Power Company the contract for street lighting for a period of 10 years, and at a rate of $72·70 per lamp, as against the previous $60 per lamp. The city retains the right to cancel the contract after a period of five years.

TRACTION.

HOME.

BRIDGEND.—The "Western Mail" states that the need of better railway facilities in the valleys surrounding Bridgend is being felt very keenly by a rapidly increasing population, and a joint committee of the various district councils will shortly consider a proposal to establish an extensive electric car service to link up the valleys with Bridgend and Portheawl, and to meet the fast trains at the former station. The Llwynfi, Ogmore, and Garw Valleys would, it is maintained, greatly benefit by such a service, for development in these localities is being severely restricted by reason of the inadequate travelling facilities.

BRIGHTON.—A syndicate have approached the Brighton and Hove Corporations for permission to run a service of trams from Worthing through Portslade and Hove to Preston-street, and to continue the line to Montpellier-road.

WEST HAM.—Mr. H. E. Blain, the borough tramways manager, has issued a very full report for the year ending March 31. The total revenue was £122,583 and the expenditure £86,372. The net surplus, after paying interest and sinking fund, was £5,737, and was appropriated in aid of rates. In spite of a rise in the number of passengers carried, the percentage of working expenses to receipts rose from 67 to 69%.

OVERSEAS.

MONTEVIDEO.—A draft Bill granting a concession to Mr. Edwin Steer for the construction and working of an electric railway from Montevideo to Colonia, and the execution of irrigation, water supply, and hydro-electric works, has been passed by the Uruguayan Legislature.

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ROME.—The Public Works Department have reported favourably on an application for the construction and working of (1) a tramway from Lusegana to Pieve di Soligo, (2) an electric tramway from Corsico to Abbiategrasso, and another between Padua and Abano, (3) various tramway lines in the town of Bergamo. (4) a tramway between Catania and Acireale, (5) a tramway from Pallanza-Fondo Toce to Ormegna *via* Crusinallo, and (6) a section of the Brescia-Mantua-Ostiglia tramway in the neighbourhood of Brescia. A concession has also been granted to the Società Varesina per Imprese Elettriche for the construction and working of an electric tramway from Varese to Bobbiate.

VANCOUVER, BRITISH COLUMBIA.—Once again the Electric Railways Construction Company, Ltd., has made a proposal to the park board of Vancouver for permission to construct an electric line around Stanley Park, the route to be on the water's edge. This time the proposition is to divide the earnings as follows: Necessary operating expenses; interest at the rate of 5½% on the cost of construction; 5% on the same amount for maintenance, improvements and repairs; the balance to be divided between the city and the company in the proportion of 25% to the city and 75% to the company. At the end of six years the city is to have the option of taking over the undertaking by assuming the cost of construction and the payment of a bonus on the same of 25%, or at the end of 11 years with a bonus of 20%, 16 years, 15%; 21 years, 10%. At the end of the last period, if the city does not care to assume the road, the profits over and above the mentioned fixed charges to be divided equally for a further term of 21 years. The proposal is to be further considered by the board.

PUBLICATIONS RECEIVED.

"Journal of the Institution of Electrical Engineers." September.

This issue contains, besides seven papers and discussions, and an original contribution ("The Static Balancer." by C. C. Hawkins), a full report of the annual general meeting, together with balance sheet and financial report. A title page, table of contents and index to Vol. 45 also accompanies this number, which brings the volume to a close.

ELECTRICAL APPLIANCES FOR SPAIN.

The Spanish Customs authorities publish a list of emendations and additions to the list of articles, for the acquisition of which, owing to the high cost or impossibility of production in Spain, it is considered necessary to invite foreign competition. The new list includes electric lighting apparatus, electrical and steam machinery, electrical pumps, metal railway sleepers, switches and crossings, laboratory materials and scientific instruments, heavy motor vehicles, indiarubber and hemp driving belts.

COMPANIES' MEETINGS AND REPORTS.

NEW ST. HELENS AND DISTRICT TRAMS.

The report of the New St. Helens and District Tramways Company states that the profit for the year to June 30, including £547 brought forward, is £1,589. The directors recommend a dividend on the Preference shares at the rate of 1½% per annum, leaving £390 to carry forward.

DRAKE & GORHAM.

The report for the year ended June 30, 1910, shows that after payment of all charges, including bonuses due to staff, there remains a net profit of £5,757 11s. 4d., which, with the sum of £484 13s. 5d. brought forward from the previous year, makes a total of £6,242 4s. 9d., which it is proposed to appropriate as follows: Payment of a dividend at the rate of 4% per annum, £5,000; carrying forward, £1,242 4s. 9d.; total, £6,242 4s. 9d. The number of installations carried out during the past year shows an increase, but owing to the economy effected by the use of metallic lamps, the average cost per installation is lower, while the large increase in turnover of the department for supplying the trade is a satisfactory feature in the year's record.

NORWICH ELECTRIC TRAMWAYS.

The report of the Norwich Electric Tramways Company states that the balance of profit derived from the working of the tramways during the year to June 30 is £8,377. To this has to be added £171 interest and transfer fees received, bringing the gross profit for the year up to £8,549. Taking into account the sum of £197 brought forward, the amount standing to credit of profit and loss account is £8,747. The directors recommend that £2,500 be placed to the reserve fund account, that a dividend of 1¼% be paid for the year, and that the balance of £307 be carried forward. Comparing the accounts with those for the year to June 30, 1909, the revenue has increased by £1,723, and the expenses by £1,117, showing therefore an increase of £606 in the profits for the year. Materials and wages for renewals and repairs to the track are largely responsible for the increase in expenses, which also include an amount of £540, the cost of new loops, etc. The number of passengers carried was 7,989,035, an increase of 617,511 on the previous year, and the number of car miles run was 1,034,092, as against 1,002,258. The earnings per car mile were 7·93d. and the expenses 5·94d., while the earnings per passenger were 0·99d.

CLEVELAND AND DURHAM ELECTRIC.

The directors of the Cleveland and Durham Electric Power, Ltd., have issued a circular calling a meeting at Newcastle-on-Tyne, on October 25, when resolutions will be submitted for the reduction of the capital from £1,000,000 to £700,000, by cancelling capital lost or unrepresented by available assets to the extent of: (1) £5 per share on 1,081 deferred shares held in trust for the company for the purpose of surrender (such shares to be wholly cancelled); (2) £4 10s. per share on each of the remaining 58,311 issued deferred shares; (3) £1 per share upon each of the 32,111 issued ordinary shares, such shares to be reduced in nominal amount to shares of £4 each. It is also proposed that the Preference and Ordinary shares be divided into shares of £1 each, and that the shares of 10s. each resulting from the reduction of the issued deferred shares be consolidated into shares of £1; odd shares to be called "deferred half shares." Upon such reduction taking effect the ordinary and deferred shares (including the deferred half shares) shall all be ordinary shares or ordinary half shares.

It is further proposed that the holders of the 350,000 Preference shares of £1 each shall, in respect of the financial year commencing on July 1, 1911, and of every subsequent year, be entitled to receive a non-cumulative preferential dividend at the rate of 5 per cent. per annum, and that the holders for the time being of the Preference shares issued and paid up at the date of the adoption of the proposals shall, in respect of the period ending on July 1, 1911, be entitled to receive the amount of the accumulated dividend, including arrears, being equal to 17½ per cent. upon the amount paid up on their said shares, such sum to be payable by annual instalments over twenty years, and to be payable only out of the surplus profits, commencing on July 1, 1911.

WILLANS AND ROBINSON.

There was a crowded attendance of shareholders at the Cannon-street Hotel, London, last week, when Mr. Jas. C. Peache presided at the ordinary general meeting of Messrs. Willans & Robinson, Ltd. In moving the adoption of the report and accounts, the chairman, after dealing with the figures set forth in the balance-sheet, and surveying the general position of the company, said unfortunately the increased volume of business is represented by orders taken at very low prices. During the latter part of 1908, and during the whole of the year 1909, orders were scarce. It was impossible to obtain sufficient work to keep the shops fully employed, and prices were driven down by the consequent keen competition. During the present year, 1910, there has been a marked increase in the volume of orders placed, but in spite of this the low level of prices ruling in 1909 has been even further reduced in the current year. For some time past the board has been confronted by two alternatives, viz., either to take orders at the miserably inadequate prices alone obtainable, or to give up the struggle and close the works. Of course, the directors have chosen the former alternative, and have taken orders at low prices with the object of keeping the business alive in the interest of the shareholders, and of being in a position to profit by a more healthy state of trade whenever that much-needed recovery takes place.

Although to-day prices are at the lowest level they have yet reached, and competition is exceedingly severe, not only from British rivals, but also from Continental

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manufacturers, who are able to send their products into this country without restriction, yet there are some signs that the worst has been reached, and some reason to hope that in the near future more normal conditions will prevail. Now that a sufficiency of orders has been obtained every effort is being made to take full advantage of the opportunity, and force the output of the works to the utmost. It is a fight between low prices on the one hand and reduction of cost in manufacture on the other hand. For the moment, low prices have the upper hand, but the board is confident that, given the staying power, they can meet this period of low prices without defeat. It is this absence of resources that converts what should be no more than a temporary depression into a serious source of anxiety. The difficulties this company is experiencing are apparent in the balance-sheets of industrial businesses throughout the country—especially, as many of you well know, with those businesses concerned as this company is in the production of machinery for the generation of electricity. Prices are depressed, and the electrical trade is unremunerative on the Continent as well as in this country, and one of the most disquieting features of the present situation is that Continental firms, in order to keep their shops fully employed, are offering electrical machinery in this country at prices below the cost of production. The directors are ready to take advantage of any reasonable opportunity for amalgamation that may present itself, but it is a policy that cannot be forced.

With the predominating feature of losses instead of profits, I can hardly expect the shareholders to take a lively interest in the technical aspect of the company's products, but that is all the same, a vital feature in the prospects of the company. In the past, Willans & Robinson have been in the forefront in the excellence of their manufactures. For success in the future it is no less important that this characteristic should be maintained than that the commercial business of the company should be handled with ability and discretion. A year or so ago it became apparent that if Willans & Robinson were to maintain their position as leading steam turbine builders it was necessary that they should abandon the type of turbine hitherto made in favour of a type better able to compete with the new turbines developed in America and on the Continent, and introduced from those countries into England. The result has been the development of a new steam turbine called the disc and drum turbine. A complete series of new patterns and tools have been made for producing this new turbine, several of which turbines are now at work and are giving excellent results, and nearly the whole of the turbines at present under construction are built on this new pattern. One first effect of this change has been to adversely affect our profit and loss account, both on account of the cost of patterns and tools, and also owing to the delays and difficulties in the shops which the change has necessarily entailed. The initial source of loss is now at an end, and the company is in a position to build all sizes of these new turbines at a reasonable cost, and with confidence that there is no better turbine made. The Diesel oil engine is another important branch of the company's business. Until recently the company has (under agreement) been able to build for the Diesel Company only. This agreement terminated on October 1, and the company is now free to supply not only to the Diesel Company, but for the general market also. There is a wide field for the use of the Diesel engine, and this freedom to sell throughout the world gives a valuable opening for widening the basis of the company's operations. Work in progress, £78,339, is unusually high. This is partly due to the recent increase in the volume of work in the shops, but is mainly due to one large contract for which the customers could not take delivery. The past half-year's profit and loss account suffers from the loss of profit which this contract would have shown, and the current half-year will, of course, profit by it.

The Chairman then referred to the very valuable addition of Mr. Davenport as joint managing director, who, he said, had shown great pluck in throwing in his lot with the company at a time of difficulty. The board owed much to his courage and resource in dealing with the very difficult problems that had faced them.

Dr. Davenport seconded the resolution, and affirmed a strong belief in the sound position of the company, which was suffering from deplorable competition. The proposed extension of borrowing powers would enable the company to make those financial arrangements with customers which were so desirable in the interests of the company.

A somewhat lengthy discussion ensued, and the Chairman having replied to the points raised by the shareholders,

The resolution, on being put to the meeting, was carried unanimously.

At an extraordinary general meeting which followed it was agreed to alter the articles of association so as to increase the power of the directors to borrow money for the financing of the contracts in hand.

A hearty vote of thanks to the chairman and directors brought the proceedings to a close.

COMPANIES REGISTERED.

Brussels Improvements (1910), Ltd.—Capital, £10,000, in £1 shares. Objects: To construct, equip, improve and work railways, tramways, docks, harbours, piers, wharves, canals, reservoirs, water, gas, electric light, telephone, telegraph and power supply works, markets, public buildings, etc., and to adopt an agreement with G. O. H. Klopp, W. G. Kent, K. P. Hawksley and G. Defosse. Private company. The first directors (to number not less than two nor more than five) are: G. O. H. Klopp, W. G. Kent, K. P. Hawksley and G. Defosse.

Llangefni Electric Light & Power Company, Ltd.—£3,000, in £1 shares (2,750 Five per cent. Cum. Pref. and 250 Ord.). Business: That indicated by the title. Minimum cash subscription 1,250 shares, Office, 66, Victoria-street, S.W.

The Telephone Subscribers' Protection Association.—Registered without capital, being limited by guarantee, to combine telephone users for the protection of their interests, and, among other things, to secure from the Government, when the transfer of the National Telephone Company to the Post Office takes place, the lowest possible rental charges consistent with efficiency. The signatories are: John Headrick, dyer's manager, 9, Lyndhurst-gardens, Glasgow; Alexander Barnwell Nicolson, master painter, 5, Kelvinside-gardens, Glasgow; Finlay Cook, company manager, 144, St. Vincent-street, Glasgow; Thomas Lockhart, master painter, 244, Great Western-road, Glasgow; James Wilson, auctioneer, 261, Hope-street, Glasgow; David Bell, Merchant, 212, Hope-street, Glasgow; and Thomas Gentles Laurence, chemist and druggist, 3, Charing-cross Mansions, Sauchiehall-street, Glasgow. Registered office: 144, St. Vincent-street, Glasgow.

Perry & Lawson, Ltd.—Capital, £1,000, in £1 shares. Objects: To carry on the business of electricians, engineers, manufacturers of and dealers in electrical apparatus, etc., and to adopt an agreement with G. Lawson and W. P. Perry. Private company. The first directors (to number not less than two nor more than five) are: G. Lawson and W. P. Perry. Qualification, £50. Registered office, Prudential Buildings, Market-place, Wednesbury, Staffs.

J. B. Saunders & Company.—£20,000 (£1) (6,000 "A" and 14,000 "B"). To take over the business of electric and mechanical engineers and contractors carried on by W. H. Radcliffe Saunders, J. H. P. Berthon, and S. G. Leech, at 91, York-street, Westminster, and elsewhere, as J. B. Saunders & Company. Private. 91, York-street, Westminster.

New Development Company, Ltd.—Capital £5,000, in £1 shares. Objects: To promote, finance, subsidise, and assist companies, syndicates and partnerships carrying on or intending to carry on electric light or other electrical or kindred undertakings, to acquire, hold and deal in shares in such concerns, and to carry on the business of an electric light or supply company, etc. Private company. The first directors are to be appointed by the signatories. Qualification, five shares. Registered office, 11, Bedford-circus, Exeter.

ELECTRIC LIGHTING AND DIRIGIBLES.

We learn that the "Leitner" system of automatic electric lighting is installed on the Clement-Bayard Dirigible, which made the memorable successful flight from Paris to London.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 139, Fleet Street, London, E.C.

CONTRACTS.

CITY OF PETERBOROUGH.

ELECTRICITY SUPPLY.

TENDERS FOR CABLES.

The Electricity Committee of the Peterborough Corporation are prepared to receive Tenders for supplying about 4,716 yards of Distributor Cables.

Specification and Forms of Tender may be had on application to my office, where sealed tenders marked "Tender for Cables" must be delivered on or before Thursday, November 3, 1910.

The lowest or any Tender will not necessarily be accepted, and the Contractor will be required to pay the standard rate of wages.

JOHN C. GILL, A.M.I.C.E.,
City Electrical Engineer.

Municipal Offices, Peterborough,
October 20, 1910.

JOURNAL OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

Edited by P. F. Rowell, Secretary.

Part 204. Price 5/-

"EARTHED INSULATED NEUTRALS IN COLLIERY INSTALLATION." (*With discussion*). By W. W. Wade.

"STANDARDISATION OF FUSES" (*With discussion*). By H. W. Kefford.

"TELEPHONE RELAY" (*With discussion*). By F. G. Brown.

"ISOLATED ELECTRICAL PLANT" By R. C. Plowman.

"THE THEORY AND DESIGN OF CURRENT TRANSFORMERS" By A. P. Young.

"COLLECTION OF CURRENT AT HIGH PERIPHERAL SPEEDS" By P. J. Cottle, B.Eng. and J. A. Rutherford, B.Eng.

"THE HIGH TENSION SPARK DISCHARGE IN AIR" By D. Kemp, M.S.,Tech. and W. A. Stephens, M.S.,Tech.

"THE LOCALISATION OF BREAKS IN SUBMARINE CABLES" By W. H. Young, B.Sc.

"THE THEORY OF STATIC BALANCER" By C. E. Hawkins.

"REPORT OF THE COUNCIL" for year 1909-1910.

Messrs. E. & F. N. SPON, Ltd., 57, Haymarket, S.W.

CONTRACTS OPEN.

HOME.

DUBLIN.—The United Tramways Company, Ltd., invite tenders for the supply of general stores, including car fittings, iron, steel, castings, oils, paints, glass, brushes, ironmongery, harness materials, electric supplies, timber, etc., for the year ending December 31, 1911. Forms (2s.) from the Secretary, 9, Upper Sackville-street, Dublin. Nov. 7.

HESWALL, NEAR BIRKENHEAD.—The Committee of the West Derby, Liverpool and Toxteth Park Joint Hospital invite tenders for a complete installation of electric light and plant at the Hospital for Consumptives, Heswall. Particulars from the Clerk to the Committee, Union Offices, Liverpool. Oct. 24.

MORECAMBE.—The Corporation invite tenders for the supply of 2,400 tons of slack to be delivered over a period from December, 1910, to May, 1912. Particulars from the Town Clerk. November 1.

PETERBOROUGH.—The Corporation invite tenders for the supply of 4,716 yards of distributor cable. Particulars from the City Electrical Engineer. November 3.

WIGAN.—The Borough Council invite tenders for the supply and erection of two electrically driven centrifugal pumps. Particulars from Waterworks Manager, Wigan. Oct. 22.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage, électrique à Béni-Souef—Offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministere de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2% of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

FOCSHANI, ROUMANIA.—The Commune invite tenders for the electric lighting of the town. Tenders, which will be opened on November 2, should be accompanied by a preliminary deposit of 35,300 lei (about £1,400), and addressed to "La Mairie de la Ville de Focshani," Focshani.

SYDNEY.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to November 16, for the supply of telephone, telegraph, and electric light material (Schedules Nos. 27–43). A deposit will be required with each tender. Local representation is necessary. For copies of the specification, and forms of tender in regard to each of the above contracts application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications, together with drawings, may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

BINGLEY: F. A. Darwin, Clerk to the County Council, Wakefield. Laundry, gymnasium, and engineering block at the new Training College.

BIRKENHEAD: Kirby & Sons, architects, 5, Cook-street, Liverpool. Extension to Nurses' Home, etc.

BRECON: C. W. Best, surveyor, County Hall, Brecon. Alterations (additional class and masters' rooms) at Mount-street School.

CORK: A. Hill, architect, 22, George-street, Cork. Re-building of Munster and Leinster Bank premises.

DONCASTER: P. Brundell, architect, Princes-street. Three shops and manager's house, at Carcroft, for the Doncaster Mutual Co-operative Society.

GATESHEAD: Newcombe & Newcombe, architects, Pilgrim-street, Newcastle-on-Tyne. Home for Aged and Infirm on Whinney House Estate.

HANLEY: Maddock & Sons, architects, Hanley. Workshops and warehouses.

LEEDS: Education Department, Calverley-street. School at Bramley.

MANCHESTER: Town Clerk. Municipal School, Gibbon-street, Beswick, Manchester; and Infant Municipal School, Clarendon-road.

MERTHYR TYDFIL: Clerk to the Guardians, 134, High-street. Maternity Block at the Workhouse Infirmary.

MILFORD HAVEN: Clerk to the Education Committee, Haverfordwest. Erection of new buildings and alterations at the Council's Schools.

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200 to 250 Volts. 32 Watts.
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DELIVERY FROM STOCK.

PRICE LIST AND TERMS ON APPLICATION.

Telephone: Gerrard 1728.
Telegrams: "Bulbolite, London."

Head Office and Works:
BRIMSDOWN, M'SEX.

Imperial Lamp Works (Brimsdown) Ltd.,
SALES DEPARTMENT,
KINGSWAY HOUSE,
KINGSWAY,
LONDON, W.C.

MONKSWEARMOUTH: R. F. Dunnel, Secretary, York. Extension of goods warehouse and new offices to North-Eastern Railway Company.

TIDWORTH: H. De La Bere, Director of Army Contracts, War Office, London, S.W. Mortuary and Disinfecting Station, Military Hospital, Salisbury Plain.

TREFOREST: Gibson, Parry Williams & Company, architects, Pontypridd. Erection of 12 semi-detached villas.

WITHINGTON: City architect, Manchester. Erection of baths.

NOTES.

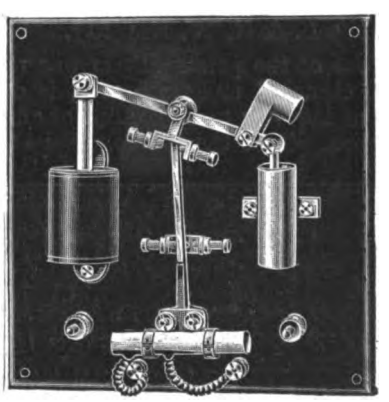
Improved House Service Cut-Outs.

At this season of the year the majority of station engineers are engaged on the pleasant duty of coupling up new consumers. Any details as to improvements in such accessories as house service cut-outs are therefore important to them, and so the leaflet recently issued by the Edison & Swan United Electric Light Company, Ltd., Ediswan-buildings, 36-37, Queen-street, London, will be received and read with interest. The leaflet deals with an improved form of service cut-out which has been specially designed to comply with the most rigid requirements. The base is of vitreous porcelain fixed in an asbestos lined cast iron case. The cover, which is also of cast iron, and lined with asbestos, is provided with a small inspection window through which the fuse can be viewed. All live metal parts are, of course, thoroughly shrouded so as to reduce the risk of arcing, even with a heavy short-circuit, to a minimum. Insulating bushes are provided, and the case can be sealed in the usual manner. A complete range of standard fuses for motor and house service work is now made in this type with 3 inch, 4 inch and 6 inch break, according to the current with which they are to work.

The pattern with 3 inch break is made in 25 and 50 ampere sizes for use on non-inductive circuits up to 250 volts pressure; the 4 inch break is used for 25, 50, 100 and 250 ampere sizes on non-inductive circuits up to 500 volts pressure, or on inductive circuits up to 250 volts; whilst the 6 inch break is used on the 25, 50, 100 and 250 ampere sizes for use on inductive circuits up to 500 volts pressure. A copy of the leaflet will be sent to any engineer or contractor who is interested in these appliances.

A New (Patent) Magnetic Flasher.

Messrs. Veritys Ltd., of King-street, Covent-garden, have recently acquired the manufacturing and selling rights of a new automatic flashing device from the patentee, Mr. A. H. Brackensieck, which they are now placing on the market as the "Aston" Magnetic Flasher. This apparatus actuates by means of the current which is taken by the



sign passing through a coil having a solenoid, the action of which is damped by an oil dash pot, the make and break contact being obtained by a mercury tube, and with this apparatus any desired adjustment can be obtained; also the period of the "light and dark" can be correspondingly adjusted. The flashers are made from sizes from 1–25 amperes either single way or 2 way, and are placed in simple series with the sign.

Theatre Lighting.

It appears that the contract for the complete electrical equipment of the Lewisham Hippodrome has been placed with Messrs. Siemens Brothers Dynamo Works, Ltd., who have sub-let the wiring work to Messrs. G. E. Taylor & Company, Bush-lane, Cannon-street, London, E.C. It may be of interest to state that the Hippodrome will be lighted throughout by Siemens fittings and "Tantalum"

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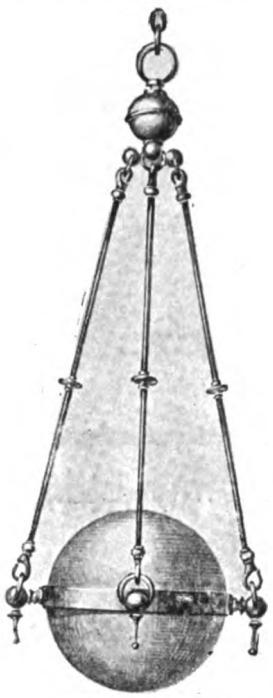
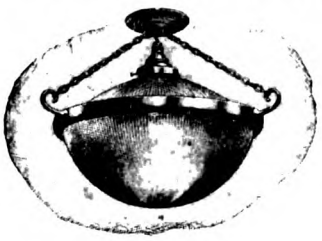
lamps, and the circuits protected by Siemens "Zed" fuses. "Stannos" wires have been specified for the wiring, and it is intended that the Hippodrome shall be equipped with the most up-to-date and efficient system of illumination and lighting effects.

New Holophane Fittings.

The Simplex Conduits, Ltd., have issued a new catalogue of Holophane ware. This catalogue is the most complete issued of this material, and also includes a wide range of fittings specially designed to meet the requirements of the Holophane system of illumination. Particular care





has been taken in pointing out the various uses of the different types of reflectors. The list also gives particulars of the new extensive, intensive and focussing types of reflectors, with full details as to their application and spacing. The fittings listed range from £1 up to £20 each, suitable for simple residence lighting or for large public buildings. Our illustrations show a reflector bowl ceiling fitting, 10 in. size, which is priced as low as 22s., inclusive of glass ware, suitable for illuminating a small room 14 ft. by 10 ft., and a sphere fitting suitable for lighting corridors, and so forth. It will be noticed that in place of the ordinary chain, down rods are provided, through which the flexible is lead, thus keeping it out of sight, which is apt to spoil the contour of the design.

Osrams on the L. & N. W. Railway.

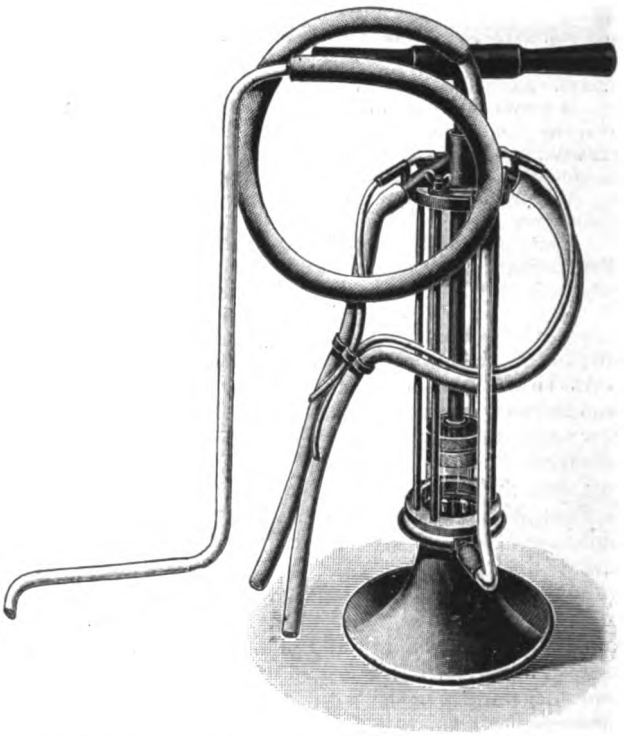
In the midst of the present Press war raging between the gas and electrical undertakings it is of considerable interest to our industry to be notified of all developments in our direction. That the gas companies are fighting a

losing battle is now no longer doubted by the public at large. The greatest proof that can be offered in favour of this assertion is the fact that all our large public buildings, open spaces, and railways, etc., when extending their illumination arrangements immediately call upon electricity. One of the many recent instances which have come to our notice is that of Mayfield-street-station, Manchester—newly built by the London & North Western Railway Company to deal with local traffic. The platforms are lighted throughout by Osram lamps with remarkably good results—36 400 c.p. 200 volt lamps being used. These are arranged in fittings which have been supplied by the General Electric Company, Ltd., hung on chains from girders 15 feet from the bottom of globe of fitting to ground, and arranged 60 feet apart. The work has, we understand, been carried out by Messrs. Collier & Company, 29, King-street-west, Manchester, who are undoubtedly to be congratulated upon being interested in what is undoubtedly an exceptionally good example of railway platform lighting. The above illustration has been reproduced from an untouched photograph taken at night time, and serves to give an idea of "the Osram effect."

"UNICA" ACCUMULATOR SEDIMENT PUMP.

The "Unica" accumulator sediment pump, of which we give an illustration, is a new means for cleaning out the sediment and other foreign matter which is liable to gather at the bottom of accumulator cells. This clearing out usually involves a large amount of labour and expense.

The "Unica" pump, placed on the market at moderate prices, pays for itself, for it allows the station engineer to keep his battery constantly clear of sediment, and, therefore, in permanent and efficient working condition. It will also save him the inconvenience and heavy cost of frequent renewals of plates, thus reducing the cost of maintenance of the battery to a minimum. The pump is made in two sizes of guaranteed acid-proof materials. It is of a simple, compact design, light in weight, easily portable, and has no stuffing boxes or packing, subject to



wear and tear. Size 1 will lift 5·28 gallons, and size 2 2·64 gallons of lead sediment, etc., from the bottom of the cells without requiring the plant to be shut down or the plates to be taken out of their receptacles.

The "Unica" may also be used for filling up of acid or distilled water. Another useful feature is that acid can be pumped up to a great height, the pump being suitable for both suction and delivery up to about 32 feet.

The great and numerous advantages derived from the use of this modern appliance, which should constitute one of the most important accessories of every battery plant, are fully described in a circular, which may be had free on application to the sole selling agent for the United Kingdom and the British Colonies, S. Heilpern, 5, Arcade-chambers, St. Mary's Gate, Manchester.

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PATENTS.

Vapour Electric Apparatus.

14857.—1910. Dr. E. Podzsus, Rixdorf. The invention consists in discharging the vapour arc through a fireproof pipe tightly joined to one or both of the electrode chambers and which affords the only path for the arc between the electrode chambers and which affords the only path for the arc between the electrodes. The pipe is a bad conductor of electricity. In use it becomes white hot and luminous and forms the light emitting body of the apparatus.

Electric Collectors for Maintaining Connection Between Stationary and Moving Conductors.

15682.—1909. B. and E. Thomas, Hulme. The collectors have rings with annular grooves suitably supported and insulated. Flexible fixed contacts enter the grooves and make electrical contact with their sides. The contacts are supported by studs to which they transmit current. The axes of the studs are bent at right angles to the axis of the collector, and tangential to the near part of the rings to allow relative axial movement of the collector rings.

Electric Mechanism for Writing and Changing Colour Signs.

18583.—1909. R. F. Venner and R. C. Griesbach, Westminster, S.W. This is an improvement in electric controlling mechanism for colour signs in which means are provided which will prevent sparking at the moving contacts of the writing and colour changing device. The controlling shaft is driven from a small electric motor at an appropriate speed for directly operating the contacts of the writing device, which may consist of flat spring contacts lifted by tappets or bent arms fast on the controlling shaft. This shaft has a cam for intermittently closing and opening the intermediate carbon switch in such a manner as to ensure a quick make and break for the lamp circuits and to govern the period between the make and break of the colour changing device.

Ceiling Rose with Detachable Plug Connection.

20435.—1909. A. H. Shaw, Blackburn. The object is to facilitate the attachment and removal of an electric light pendant suspended by flexible or solid wires from a high voltage ceiling rose plug or cut-out without the aid of a screwdriver. The porcelain plug carries two diametrically opposing contacts and a spring, and is formed with channels to constitute a cord grip. The base has contact pillars to receive the leading in wires and a cover with slots to allow the insertion of the plug in one position only so that the plug may be retained therein when the contacts are disengaged, whereby each light can be cut out of circuit without the aid of switches.

Electric Clocks.

20496.—1909. G. B. Bowell, Margate. A double cam shaped armature is operated upon in turn by an electro-magnet and a permanent magnet so that a definite turning effect is produced throughout the whole of its cycle. This ensures a definite step by step motion for the dial.

Electrically Heated Apparatus.

20639.—1909. A. F. Berry, Ealing. This apparatus comprises a metal mass of large heat capacity having an exterior heat radiating surface completely protected during the heat storage period by an insulating cover which can either be entirely removed to enable the stored heat to be rapidly utilised when so desired, or allowed to remain to enable heat conducting supports for the utensils to be passed through the corner and brought into and out of contact with the metal mass.

Electricity Meters.

20815.—1909. Siemens Bros. Dynamo Works, Ltd., Westminster, S.W. The invention provides a simple means for indicating the amount due from a customer to the supply authority on account of electric energy supplied. The speed of the registering mechanism is proportional to the square of the current flowing. The meter record for an arbitrary chosen period of time is equal to the mean square of amperes flowing through that time multiplied by the square of the supply voltage multiplied by the number of hours in such time and divided by one million.

Dynamo Electric Machinery for Starting Purposes.

20827.—1909. A. G. Brown, Boveri & Company, Baden. In order to start polyphase motors having no commutators by means of commutator starting generators which are to be excited with varying voltage and periodicity, a commutator machine is employed for exciting the starting commutator machine.

Controlling Electrical Quantities by means of Sound Waves.

21441.—1909. F. J. Chambers, Slough. This method of varying the constants of an electric circuit consists in providing as part of the circuit a continuously flowing liquid. The rate of flow is varied by the action of sound waves.

Generating Heat by Electric Currents.

22997.—1909. H. A. Kent, Bounds Green, N. The object is to produce an apparatus which will convert a current of electricity into heat in an effective manner. The heat generator consists of metal tungsten in a granular form packed into silica glass tubes. The tubes may contain an inert gas or may be exhausted. The wires for conducting the current are melted in at each end of the tube.

Voltage Regulation of Alternating Current Circuits.

23416.—1909. General Electric Company, Schenectady, U.S.A. The object is to provide simple and effective means for compounding the voltage of the circuit with varying load. Two transformers are employed having their primaries connected in series with each other and in shunt to the source of voltage for the circuit and their secondaries connected in series with each other and the load. The cores of the two transformers are so proportioned that one is saturated and the other unsaturated.

Electric Transformers.

23649.—1909. General Electric Company, Schenectady, U.S.A. The object is to construct a transformer which will give a smaller short circuited current than is given by those transformers at present in use. For this purpose the secondary winding is divided into two portions, one of which is so wound that there will be a large percentage of magnetic leakage between it and the primary winding. The second portion is wound in a reverse direction to the first portion and in close proximity to the primary winding, so that the magnetic leakage between it and the primary winding will be small.

Electric Storage Battery Separators.

25273.—1909. Accumulatoren Fabrik A.G., Berlin. After a treatment with an acid or alkaline solution the wood of which the battery is to be constructed is soaked in a 10% solution of glycerine for from one to two hours. The wood is then dried by air, after which it will be found to possess a certain flexibility and will not require to be kept under water.

Ventilation of Electric Motors.

26005.—1909. H. A. Mavor & Mavor & Coulson, Ltd., Mile End. The motor has an armature with radial ventilating passages. The natural action of the ventilating current of air through the radial passages of the armature is supplemented by the exhausting action of a fan of radial type at one end of the motor. A second fan forces a ventilating current in an opposite direction through the stator between the field magnets.

Machine for Covering Electric Cables.

1290.—1910. C. Sattler, Steglitz. The machine has a device for feeding the cable to the covering mechanism. The feeder comprises several discs around which the cable is wound. The feeding and covering devices are simultaneously driven by a belt set in motion by a main shaft.

Automatic Telephone Exchanges.

8228.—1910. E. Neuhold, Friednau. This is a system of connections for restoring to the position of rest selectors which are electromagnetically adjustable in two directions by connecting one of the two moving magnets to an intermittent current supply which is disconnected by the selector returning to its end position. This connection of the one moving magnet is effected by the subscriber on the conclusion of a conversation through the medium of the other moving magnet.

Control of Alternating Electric Current Induction Motors.

8621.—1910. Allgemeine Elektricitats-Gesellschaft, Berlin. This is a method for regulating the speed of induction motors arranged in cascade connection with commutator motors. The rotor winding of the induction motors is arranged in a number of groups, which are adapted to be coupled in series parallel connection.

Alternating Current Commutator Electric Motors.

6124.—1910. Siemens Schuckertwerke, G.m.b.H., Berlin. This is an improvement in alternating current commutator electric motors of the kind which start up as repulsion motors and afterwards run as ordinary asynchronous induction motors. When such motors act as repulsion motors the brushes are connected together electrically and displaced by a fixed amount from the neutral position on the commutator and the motor torque is produced by the current which flows through these brushes. When the motors act as induction motors the commutator and brushes are no longer used, as the rotor or armature winding is short circuited in the usual manner. A short chord rotor winding is employed in this improved motor and connected to a commutator and brushes. The torque producing magnetic field is excited by rotor ampere turns. By short circuiting the rotor winding the commutator and brushes are made electrically inoperative.

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PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

IMPROVED GAUGE FITTINGS, ETC.

When asbestos-packed gauge cocks and valves were introduced some years back, everyone recognised that they showed a decided improvement upon the old-style fittings, and nowadays they are almost universally employed. Nevertheless, they are admittedly far from being perfect, for after a certain period they invariably start leaking, and before very long the entire fitting has to be removed from its position and sent to an engineering shop for repair ere it will render efficient service again. This entails considerable waste both of time and money.

Two conditions contribute to such failure on the part of ordinary asbestos-packed cocks and valves. Firstly, the asbestos packing gradually wears away, and to re-pack the fitting special machinery and skilled labour must be employed. Secondly, the combined action of steam, water, high pressure, chemical conditions, foreign matters, etc., will ultimately wear away the small metal surfaces which move upon each other in the centre of the cock, and nothing appears to be able to entirely eliminate this wear and tear, which occurs just at the point where good service is most needed.

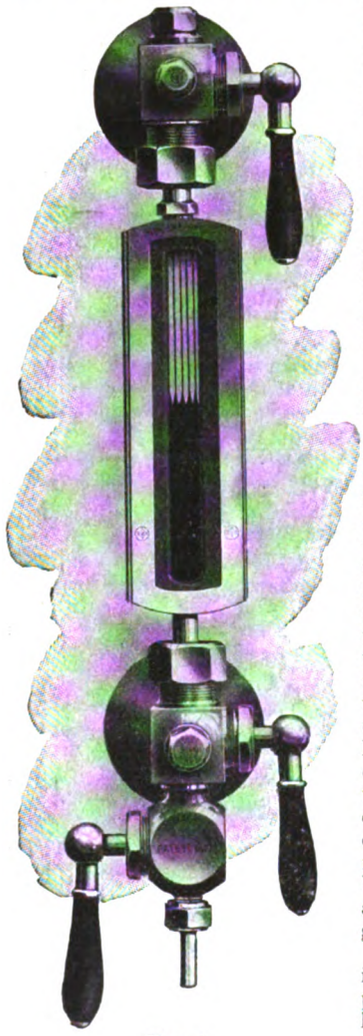

FIG. 1.

Klinger's Improved Gauge Cocks are devised on entirely novel and original lines, effectually overcoming the above-mentioned trying conditions. The new principle is applied to both upper and lower gauge cocks, as well as the blow-off cock, and may be described as follows:

The cock or valve body is hollowed out for the reception of a removable inner cup or lining, the outside of which fits accurately into the said hollow. This lining is filled with best quality asbestos packing, the plug working in the centre in the usual manner. Only after long service will the cock first begin to "blow," when tightening the plug cover nut in the usual way will meet the case. When eventually the packing becomes quite inefficient, the entire lining can be removed without taking down the rest of the fitting, and a new lining complete with fresh packing can be substituted in a few minutes. The exchange can be effected by any workman, and will make the cock as good as new.

The advantages of this invention are at once apparent. As the gauge casing lasts indefinitely and never needs to be removed from the boiler, the delay caused by dismounting and sending the ordinary pattern cocks to be repaired is entirely avoided.

These improved cocks can be fitted with either Klinger's patent "Reflex" Water Gauge, attachable pattern, as shown in Fig. 1, or with an ordinary glass tube. In Fig. 2 is shown a sectional drawing of the internal arrangement of a blow-off cock. All other types of these fittings are on the same principle.

Klinger's patent "Reflex" Water Gauge, attachable pattern, shown in Fig. 1, is a long-standing favourite with the engineering world. Over 200,000 have been sold, which should be sufficient to make everyone investigate the remarkable claims made for it.

Briefly, it consists of a gunmetal casing with a flat glass "window," so designed that the water space appears as if black, thus enabling the water level to be instantaneously observed even at a distance, whereas the ordinary gauge very often requires quite close inspection to ascertain the height of the water in the boiler. The importance of this may be easily tested by filling a glass tube with water. At a very short distance one cannot judge for a certainty whether there is water in the tube or not. That is, it looks alike, whether full or empty. Therein lies the danger, if such a tube be fitted on a boiler. The difference between full and empty may mean the difference between working efficiency and a violent explosion. It is best to avoid the risk.

Klinger's "Reflex" Water Gauge has the following supreme advantages: The water level can be seen at a glance and from a considerable distance. The gauge is a certain safeguard against

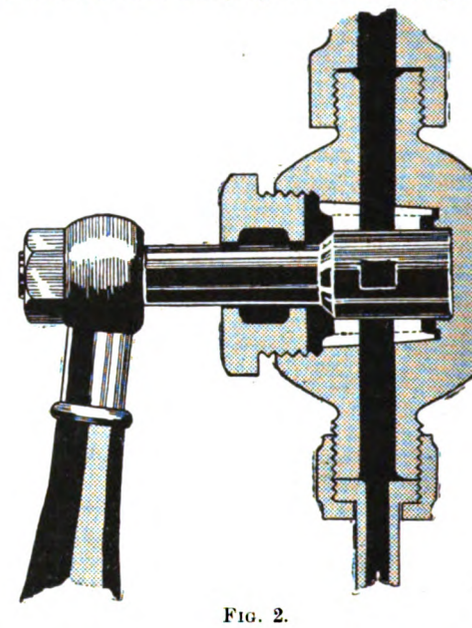

FIG. 2.

explosions and does away with the need of a protector. There are no glass tubes to break, and by avoiding the possibility of explosion it entirely eliminates all danger to workpeople. It is easily fitted to any existing boiler mountings. To sum up, the saving a Klinger "Reflex" Gauge effects in time, trouble and expense is so considerable that every steam user who has not already done so will find it well worth while to investigate its merits without delay.

The other illustration (Fig. 3) shows clearly the ingenuity and simplicity of Klinger's patent Stuffing-Box Packing, the latest specialty introduced by this firm. The body of the packing consists of (1) a special fibrous lubricant, embedded in which is (2) a perforated strip of flexible metal, and the whole is encased in (3) an interlaced cotton covering, one side of this being coloured red to denote that that side must be placed directly in contact with the piston rod. The metal strip, being flexible,

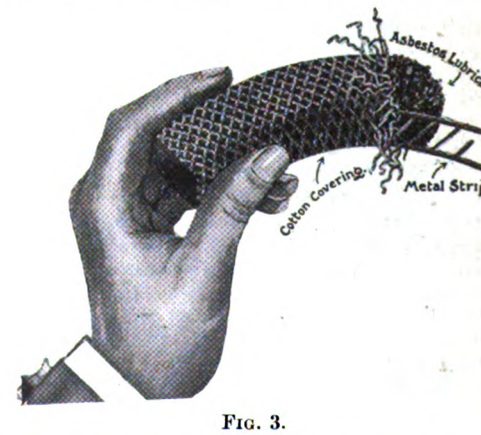

FIG. 3.

may be readily bent round any diameter of valve spindle or piston rod, and the lubricant material, being forced through the perforations by the pressure of the gland, forms a perfectly tight joint. As the stuffing-box is tightened from time to time, a fresh supply of lubricant is pressed through the perforations in the strip of metal on to the piston rod, which is thus automatically lubricated. The packing being made up of a number of rings, each independent of the other, it is resilient throughout the whole length of the stuffing-box—an advantage every engineer will appreciate. Klinger's packing is impervious to the effects of water, superheated steam, acids, ammonia, oil, etc., and is, therefore, the one packing for all purposes.

Full particulars can be obtained from the manufacturers, Richard Klinger & Company, 66, Fenchurch-street, London, E.C.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

Old Series, Vol. LI.
New Series—No 18, Vol. XLVI.

LONDON, OCTOBER 28, 1910.

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Registered at the General Post Office.

NOTES.

Electrical Exhibition.

In a little less than a year hence—from September 23 to October 21, to be precise—we are to have an Electrical Exhibition at Olympia, West Kensington. It is to be promoted by the National Electrical Manufacturers' Association, under the Presidency of Sir W. H. Preece, K.C.B., F.R.S., and organised by those experts in exhibition affairs, the International Trade Exhibitions, Ltd. Although it is yet early to go into details, it is evident that the show is intended to be thoroughly comprehensive, and having regard to the auspices under which it will be held, there can be no doubt that it will be representative and interesting. Primarily intended for engineers, the exhibition will unquestionably appeal to a very large percentage of the population, for electricity is making giant strides and has caught the popular fancy. Conducted with discretion and energy, as we have every reason to expect this will be, the exhibition should prove a valuable help in promoting the revival in electrical industry. We shall have more to say on this subject in future issues.

Electric Drive in Indian Mills.

One of the important items of news to hand from India is that the Hindusthan Cotton Mills Company, Ltd., of Calcutta, a concern promoted by Zemindars and local citizens, is to be equipped electrically. The chief work of the first will be to weave fancy cotton goods and long-cloths. The company have offices at 1, Hare-street, Calcutta, and their expert is Mr. B. M. Chatterjee, who was trained at the Leeds University, and then had practical experience in Yorkshire and Lancashire mills. After careful investigation, it has been decided that electrical power will give the best results, both as regards economy and efficiency. A great point, too, with the promoters is its cleanliness. Power, it is understood, will be taken from the Calcutta Electric Corporation. This is yet another proof of the intelligent interest being taken in industrial electricity by Indian business men.

Central Stations and Electric Traction.

It is scarcely to be wondered at that the St. Marylebone Borough Electricity Undertaking should feel the result of economy of current following on the introduction of the metallic filament lamps. For the borough is essentially a residential and shopping district, where the manufactory element is scarcely represented. But although there is a falling off in the amount of electricity consumed, there is a notable increase of consumers demanding supply. New customers, and customers increasing the number of their lamps, however, hardly compensate so far for the saving of current. So the authorities have looked around for fresh outlets. As the manufacturing field is limited, the happy idea is being developed of offering electric power at special rates for road traction. Taking all the horseless vehicles on our streets, the percentage of electrically-driven cars is much lower in London than it is in Paris, and certainly very much lower than in most American cities. But then, in Paris, as in America, central stations make a special appeal to automobilists, offering considerable facilities to those requiring electricity for their cars, and it is found that the game is quite worth the trouble.

Prospects of Development.

Already the Marylebone enterprise is assured success. Negotiations are going forward with a firm contemplating inaugurating a scheme of 15 electric motor omnibuses between Edgware-road and Liverpool-street. A second firm proposes to start a similar service in another direction; while a third firm contemplates building a fleet of 50 electric vans of different sizes for hiring out to traders. All that is required is a reliable supply of electricity at a moderate price. There are quite big possibilities in this direction, and it is a development particularly worthy of attention, because it would tend to equalise the load. It is doing so in America, and could easily be made to serve the same useful purpose over here. Mr. Seabrooke is to be congratulated on his enterprise.

Municipal Telephones.

At the last meeting of the Hull Corporation Committee before the November elections, a statement of the future prospects was made. It is well known that the Corporation's telephone licence expires next year, and that a large section of the business community is extremely anxious that a renewal of the licence should be obtained from the Post Office. There is, however, some outside opposition. The Chairman of the Committee, and the Deputy Mayor, pointed out that if the Corporation are to gain their way, support must come from the ratepayers. So far the support has been excellent, for there are over 3,000 telephones in daily use. Good service is given, and the business is carried on at a profit. The problem is whether this branch of municipal enterprise at Hull will continue to be extended, or whether, as at Glasgow, it will be absorbed by the Post Office.

Electricity and Motor Cars.

Reverting to our remarks of last week on electricity and motor cars, Mr. F. W. Lanchester advocated a special combination. He said that in the simplest and most straightforward application of the petrol electric combination a direct current dynamo is mounted on the engine bed plate, and the engine and dynamo shafts are keyed or bolted together so that they revolve as one. The dynamo is of the shunt wound type, and acts alternatively as dynamo or motor; it has become customary to apply to it the name *dynamotor*, a term which it is convenient to adopt. The petrol-electric installation so constituted is arranged to operate through the medium of a magnetic clutch either on the usual differential, or may be fitted in duplicate and arranged to act by duplicate worm or bevel drives direct on to the road wheels. A storage battery is provided usually of about 5 per cent. of the total weight of the vehicle, which takes up any excess power when going down hill or on a level, and which gives up the energy so stored when required to ascend a gradient. The alternative function of the dynamotor is determined automatically by the speed variation: when the petrol engine is slowed down by excessive resistance the voltage in the armature falls and the battery begins to assist to drive the vehicle; when on the contrary the engine attempts to race away, the voltage rises as a consequence, and current flows in the opposite direction and spends itself in the charging of the battery. Thus an approximately uniform speed is maintained over the whole route travelled, the vehicle takes but little notice of the ups and downs encountered. Likewise when stopping part of the energy is thrown into the battery, and is drawn out again when getting under way.

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SURFACE BRIGHTNESS.

A New Instrument for Its Measurement.

Concluded from page 444.

Before using the apparatus one adjusts the position of the glow lamp illuminating the opal plate until the brightness of the white surface S (as compared with another similar white surface illuminated by a standard lamp at a specified distance) is, say, exactly one foot-candle. One then fixes the lamp in this position and regards the scales as registering in foot-candles.

It is desirable to reset the lamp from time to time as the pressure of the accumulator gradually drops and the candle-power of the lamp eventually falls. In doing so it is preferable to utilise an incandescent lamp or flame-standard mounted on a photometric bench, but probably an accuracy sufficient for many practical purposes can be attained by the use of a "standard candle" placed exactly one foot away. When using such a candle (which should be obtained from a recognised source), draughts must be avoided, and it must be allowed to burn for about 10 min. or so until an even cup of molten wax is formed. The wick should also assume its normal state, being neither too stiffly upright nor sagging over horizontally so as to cause the flame to flare up. With a little care in these respects an accuracy within 10% can probably be obtained.

It is also possible to check the instrument roughly by noting the illumination under some familiar conditions. For example, one of the authors has studied the illumination on the table in his library, and during the last two months the reading, as noted with this instrument, was never more than 2·0 foot-candles or less than 1·75—a difference which might easily have been caused by a fluctuation in the supply voltage. Now for many practical purposes an observer would be satisfied with the knowledge that the instrument has not varied by more than the above percentage.

It should be noted, however, that in many cases we are only concerned with relative values when using such an instrument. For example, it may be desired to demonstrate that the illumination on a table is multiplied to a certain amount by using a certain reflector; or it may be desired only to study the distribution of illumination over a table, wall, or illuminated placard, etc. In such cases the extreme accuracy of the absolute value of the result does not greatly matter; all that is desired is that the instrument shall not vary during the measurement and that the scale shall be strictly proportional.

Range of the Instrument.—By means of the device already described one can measure values from under 1-100th to one foot-candle. It is also proposed to equip the instrument with two dark glasses, each absorbing 1-10th of the light passing through them, in order to increase the range of the instrument upwards. Either one or both of these glasses can be inserted in the path of the rays from the surface studied, thus enabling values as high as 100 foot-candles to be measured. Naturally some care is necessary in selecting glasses which do not unduly absorb light of certain colours, but there seems to be little difficulty in securing that any error so caused will not be material from a practical standpoint. As an illustration of the wide range of brightness that can be measured by this means, it may be mentioned that the writers have measured values of over 50 foot-candles in shop-windows, while it is also possible to estimate the brightness of the sky in the night-time. This proved in one case to be about 0·008 foot-candles. In another case, owing to the diffusion of light from neighbouring arc lamps, a value of 0·015 foot-candles was registered.

Accuracy of the Scale and Necessity for Supervision.—There were a large number of special difficulties originally met with in securing a uniform scale. It is necessary that the opal surface, which is ground on both sides, should be perfectly diffusive and uniformly illuminated all over. By gradual modifications in the original design the various scale errors were gradually eliminated, and it is now anticipated that the scale can be regarded as correct within 5% over its length. This order of accuracy was obtained partly by correct proportion and relative position of the lamp, opal surface, and screen, and also by enclosing the lamp in a white diffusing chamber, on the principle of the Ulbricht globe.

The authors, however, would like to emphasise the importance of careful supervision in the case of instruments of this kind, as relatively small defects may lead to considerable errors if due care is not taken. They, therefore, propose to examine personally every instrument before it is sent out for use in order to ensure that everything is satisfactory. It should, of course, be understood that the obstacles referred to above were difficulties in design only and not in use. Once the instrument is correctly made it should give anyone using it no trouble, as the parts are not easily deranged and the whole construction is simple.

Measurement of Illumination and Candle-power.—Although mainly intended for the measurement of surface-brightness, the instrument can be easily employed to measure illumination. In this case a white surface is exposed to the illumination of the standardising lamp, and the same surface is used for subsequent measurements. For this purpose a screen that is diffusive and dead white is desirable. Yet, as the same screen is used both in calibration and in experiment, any error caused by imperfect compliance with these conditions tends to "cancel out" as far as measurements of illumination are concerned. For practical purposes, good white cardboard or drawing paper, from which any glaze has been removed, answers. It is often convenient to pin into position in inconvenient corners, is cheap, and is readily replaced when soiled. The size of the surface employed naturally depends upon the distance from which it is likely to be observed. For near work a piece about the size of a half-crown is often ample, and the ability to use such a small surface enables one penetrate into crannies where it would otherwise be impossible to obtain a measurement. One case in which white card or paper is convenient is in getting a rough idea of the reflecting power of wall-papers, curtains, etc. All that is necessary is to pin the card on the material in question, and take, first, a reading of the illumination on the white card, and then of the surface-brightness of the adjacent material.

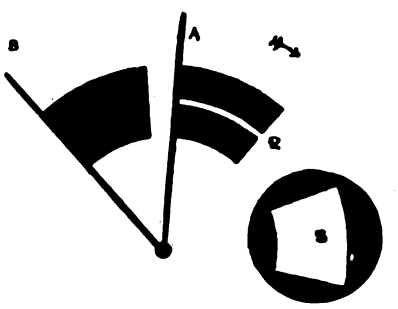

FIG. 3.

By a very simple addition the instrument can also be utilised to measure the candle-power of lamps in a room or street. A small tube terminating in an opal glass plate, ground on both sides, is inserted in front of the photometric screen. The observer then merely presents the instrument towards the lamp studied and balances the illumination of this opal plate. Then, knowing the distance of the source, he can readily calculate its intensity. It is, of course, necessary to determine once for all the constant of the instrument before use.

PRACTICAL MEASUREMENTS OF ILLUMINATION AND SURFACE-BRIGHTNESS.

The compactness and portability of the instrument, which enables it to be fixed, together with the accumulator, in a small case and carried knapsack fashion on the back, or even in an overcoat pocket, is very convenient for practical measurements.

Moreover, a measurement of the brightness of a surface by means of this instrument is unaffected, within wide limits, by the distance away of the observer.

The chief advantage of surface-brightness measurement is that it enables one to go right to the root of the matter—to study the illumination at the exact spot with which we are concerned. With the instrument described one can determine not only the illumination provided by the lighting engineer, but the resulting actual brightness of the objects illuminated. Again, in studying distribution of illumination it is often convenient to measure surface-brightness. For example, one can determine the distribution of light over a large placard or the face of a building by merely pointing the instrument in the desired direction,

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and in this way one can reach parts which it would otherwise be extremely difficult and in many cases almost impossible to get a measurement. As an extreme illustration of measurement at a distance, it may be mentioned that we attempted to measure the surface-brightness of the dial of the clock in Westminster Tower, which, viewed from the lower end of Whitehall, will just cover the aperture in the instrument. Owing to the fact that the surface is interlaced with opaque lattice work it was not easy to get an exact reading, but the apparent illumination seemed to be between 1 and 2 foot-candles.

At close quarters the method is also advantageous, because one can map out the illumination on quite a small area; *e.g.*, the distribution of light beneath table lamps, which, by the way, is often curiously uneven. Another feature of measurement of surface-brightness is that one can often obtain useful information by studying the brightness of inaccessible objects inside glass cases. For example, one can study the contents of shop windows without it being necessary to take the instrument inside among the goods, and it seems reasonable to suggest that the best method of judging whether a show window is well lighted or no is to study the appearance of the lighted goods themselves.

Again, the small white surface studied can be placed anywhere we like, so that it is easy to examine the illumination at any point on a tool or piece of machinery, etc.

Dwelling Rooms, and the Study of Wall-papers.—The instrument can be easily applied to determine both the illumination and the surface-brightness of wall-papers in various rooms in a house. All that is necessary is to set up the white surface on the wall and to measure first the brightness of the white surface and then that of the adjacent wall-paper. An incidental advantage of the method is that, the eye being fixed on the aperture, the surface behind is out of focus, so that one gets it unconscious of the pattern of the paper studied and automatically obtains a mean result.

There seems to be a lack of data regarding the desirable surface-brightness of walls although general figures have sometimes been quoted for the illumination. One would be inclined to suggest, with reservations, that a "cheerful" room should have walls with a surface-brightness, by artificial light, of not less than 0·3 foot-candles. No doubt in many rooms with very light walls much higher figures than this would be obtained, however, while in certain other cases more "subdued" effects might be desired. Under practical conditions a very fair order of accuracy may be expected in such measurements, and it might be supposed that this simple method of studying the absorbing powers of various surfaces would commend itself to architects and decorators. At all events when an idea as to the probable absorption can be so readily formed there seems no excuse for the extreme vagueness that often prevails at present.

One can, of course, easily ascertain the intensity of illumination on tables, bookshelves, etc., by attaching thereto the little white surface on the spot where a measurement is desired. In a library mentioned above the vertical illumination on the bookshelves is rather over one foot-candle and the horizontal illumination on the table in the neighbourhood of 1·8 foot-candles.

Light Reflected by Various Qualities of Paper.—The same remarks might be made regarding qualities of paper employed. One is too often inclined to suppose that if an illumination of one foot-candle is provided all has been done that can be expected to render reading comfortable. But the paper on which the characters are printed may reflect but a fraction of the light impinging upon it. When one is reading a newspaper in a lighted train one frequently suffers through this fact as well as through deficient illumination. The following figures were recently obtained for three well-known newspapers:—

	Reflecting Power (Relative).
White Cardboard	100
Westminster Gazette	90 (very approx.)
Globe	80 ,, ,,
Sporting Times ..	53 ,, ,,

And it may be added that the cardboard in question was not as white as might have been selected, so that the results are high, if anything. However, many of the papers in use, such as blue tramways tickets, some theatre programmes, etc., reflect very much less light than the above.

Studying Illumination in Schoolrooms, etc.—A great deal has been said recently about the necessity for good illumination in schoolrooms. The chief requirement in an instrument of this class is portability, and, provided it is reliable in action and not liable to get out of order, an excessive degree of accuracy is seldom called for. It is also often desirable to study surface-brightness rather than illumination, and it is important to be able to take measurements in any desired direction. For example, although a knowledge of the horizontal illumination on the desks is useful, this does not always describe the exact conditions under which the child reads. He may lift the book at such an angle that he normally receives but a fraction of the horizontal desk illumination. Or it may be that, unfortunately, there are obstructions which cast a shadow on the page as usually studied, or the paper of the book may be of an inferior quality which only reflects a small quantity of light. Therefore the most exact data regarding the illumination he enjoys would be obtained by looking through a surface-brightness photometer over the child's shoulder so as to read with the apparatus exactly that brightness which his eye would receive.

When one comes to consider illuminated black diagrams and black-boards we are concerned mainly with surface-brightness. For what really enables a child at the back of the room to distinguish the writing on the board is the contrast between the blackboard and the chalk.

Until one attempts to make measurements one would hardly credit the variations in daylight that occur even in a room liberally supplied with windows. At a technical college known to the writers there is one class-room, 30 ft. by 25 ft., with high windows all the way down the left-hand side (facing the street). Yet at 5 o'clock on a September day the illumination on the best-lighted desk was 10 foot-candles, while the worst seat received only 0·6. Moreover, the illumination of the blackboard varied from 5 foot-candles at one end to only 0·5 at the other.

Illumination in Tramcars, Railway Carriages, etc.—There are few instances of wider variations in lighting conditions than those which seem to prevail in railway carriages and tramcars. As yet there does not seem to be any regular standard adhered to, although it may safely be said that the nature of the illumination is often a powerful inducement to travellers to select one route rather than another.

The illumination provided in the tubes and underground trains of London varies very greatly. In one of the tubes by which the authors habitually travel the horizontal illumination is usually just about 1·1 to 1·3 foot-candles while the train is at rest and 0·7 to 0·9 foot-candles when the train dives into the tunnel. This value has been repeated so often that one could almost check the instrument by a reading on this tube.

In other cases readings between 2 and 3 foot-candles were obtained, while in one comparatively short journey on another tube the illumination fluctuated between 0·2 and 0·8 foot-candles. Perhaps the most remarkable instance of poor illumination was a tram in which the illumination danced about between 0·1 and 0·2 foot-candles. Yet the illumination in the next tramcar that passed along the route was over 1 foot-candle. Time-tables and clocks also often receive very little illumination. The surface-brightness of one series of time-tables immediately opposite a lamp was 0·3 foot-candles; but another series a little further along yielded a result of only 0·07! The surface-brightness of clocks in several tube stations was as low as 0·2 and 0·03 foot-candles respectively.

Other Uses of the Instrument.

As stated above, the idea of the authors is devising this instrument has been first and foremost to provide a compact and portable apparatus for the measurement of surface-brightness and illumination in any plane. In most practical cases, such as those to which reference has just been made, great accuracy is not expected. Nevertheless, special care was taken in the design of this instrument in the hope that it might also be found useful for many laboratory purposes in which the very highest precision necessary for standard work was not demanded. It is somewhat curious that in photometrical laboratories, in technical colleges, etc., there is often no means between extremely elaborate experiments and the use of inconvenient and antiquated apparatus. In many cases a student spends a needless amount of time in making calculations which might be avoided, and in consequence sometimes conceives an aversion to all photometrical experiments, as something unreliable and tedious.

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An instrument such as this in which a uniform scale is employed saves a considerable amount of time, since the result can be read off at once; and the long calculations based on the inverse square laws, usually associated with work on a photometric bench, are avoided. Probably, therefore, an instrument based on this system, which can be used to measure either surface-brightness illumination or candle-power, would often be a valuable adjunct in the photometrical laboratory. Its portability and compactness would often be an advantage, since a photometric bench take up a great deal of room and is not readily transferred from one part of the room to another. The instrument should, therefore, be serviceable for fundamental experiments by students on glowlamps, etc., as well as for illumination measurements. During an experiment the apparatus should be mounted on a short tripod. One type of experiment for which it seems particularly well suited is the study of the absorption powers of solutions and glasses, etc., and the reflecting power of different surfaces.

It might also be applied to obtaining polar curves of light distribution, since it can readily be pointed at a lamp so as to receive the light from any desired direction. Another possible method of applying the instrument for this purpose would be to fit it with an elbow tube terminating in a ground opal plate which could be rotated to any desired angle without the position of the instrument being affected.

MANCHESTER ENGINEERING AND MACHINERY EXHIBITION.

Last week we gave a brief account of exhibits generally. This week we are able to describe some of the more interesting stands in detail. Ferranti, Ltd., Hollinwood, have a great variety of electrical apparatus for the control of electric circuits, and their exhibit constitutes one of the chief attractions of the show. A line of standard motor starters, both of the ordinary fixed handle types and of special free handle types, are shown. A motor starting panel comprising switches, fuses, starter ammeter, etc., and the necessary connections, all mounted on one frame for bolting to a wall, is also on view. A variation of this gear recently introduced is called a motor starting pillar and is designed for fitting to the floor at any spot near the motor. A special series of high-class ironclad switch gear and fuses are on view. These are specially suitable for factories, workshops, etc., in exposed positions, and all the live parts are totally enclosed, only the handle projecting through the case. Another recent design is the ironclad overload circuit breaker which Ferranti, Ltd., have recently brought out to meet the new Home Office rules, which practically enact that all switches and circuit breakers which are mounted in exposed positions in factories and workshops must be of the totally enclosed type. These breakers are of magnetic blow-out overload type with free handles. They are of novel construction, and occupy very small space. All connections are brought to the front, and the insulation has been carefully attended to, so that the case may be earthed without any strain or fear of breakdown. The case is of non-magnetic metal and covers all the live parts. Excepting the 25 amp. size, the breaker is only made S.P. The smallest size, however, is also made D.P., and the firm suggest that it provides a most welcome substitute for the supply company's and consumer's fuses and switches, being much more convenient in use and no dearer in first cost. The cases are supplied either with detachable handles, of the railway key type, or fixed handles.

The chief exhibit is a three-panel example of a H.T. switchboard, beautifully finished, "foolproof," and suitable for use in collieries, mines, and other works which receive H.T. supply from an outside source. All the live parts are enclosed in iron cells. The gear included in each panel consists of an oil switch for breaking the load, an isolating switch for disconnecting the panel from the supply, cable receiver for the incoming main, and the necessary instruments, relays and instrument transformers. Each panel has removable C.T. doors at back and front. The front door is so interlocked with the isolating switches that it cannot be withdrawn until the panel is completely dead. The isolating switch is also interlocked with the oil switch, so that it cannot be opened while the oil switch is "on," that is, so that the circuit is not broken on the isolating switch. The unit system is adopted in the building up of these panels.

A large collection is shown of the ordinary patterns of open type circuit-breakers, switches, fuses, etc., and instruments, relays, etc., for use on boards, etc. A special Thermo time limit circuit-breaker is shown. This is a very simple contrivance, and consists of mechanism operated by the expansion of a metal strip, heated by the current which passes through it to the load. This expansion is sufficient to cause it to trip the switch and so open the circuit. The time limit adjusts itself to a certain extent to inversely agree with the amount of overload.

The Lea Recorder is now well known to most station engineers, and already a number of the most up-to-date generating stations in this country and abroad have installed it.

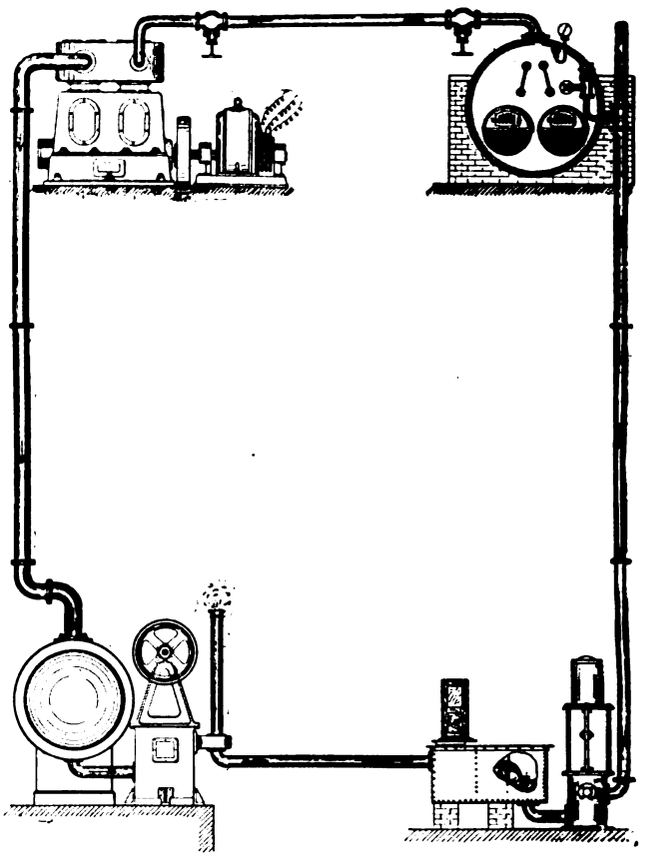

FIG. 1.—THE "SYSTEM."

The object of the instruments is to measure and record graphically the flow of water over "V" notches and weirs. The instrument may be used for testing boilers by measuring continuously the feed water, or engines and turbines by measuring continuously the condensed steam as it is discharged from the air pumps. The illustration shows the system of measurement, and it will be noted that the feed water is measured on the suction side of the feed pump, where it is not under pressure. The use of this recorder provides a check on the regularity (or otherwise) of the boiler feed. It enables the engineer in charge to see at any moment the amount of water that is being pumped into the boilers, and from its readings the amount of steam generated per day can be easily ascertained. If the coal is weighed this provides a means of checking the quality of the coal. Also should there be variations in the coal bill the reason can be very soon found, and the continuous record of all that goes on in the boiler-house provides a means of raising the efficiency of the plant. If used for measuring the air pump discharge from surface condensing engines, a continuous record is obtained of the weight of steam passing through the engine, and by taking the horse-power or kw. developed, the lbs. of steam per h.p. or per kw. are instantly obtained. By taking these observations at different loads the most economical working load is arrived at. These easily-obtained particulars enable the effects of superheat, vacuum, and other conditions effecting the

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efficiency of plant to be quickly ascertained at any moment. The fact that a continuous daily record of the steam used is provided, forming a perfect check on the steam consumption, helps to make the working of the plant very much more efficient.

Formerly, the recorder was made only as a recorder and indicating instrument, but now a third feature—an integrating arrangement—has been added.

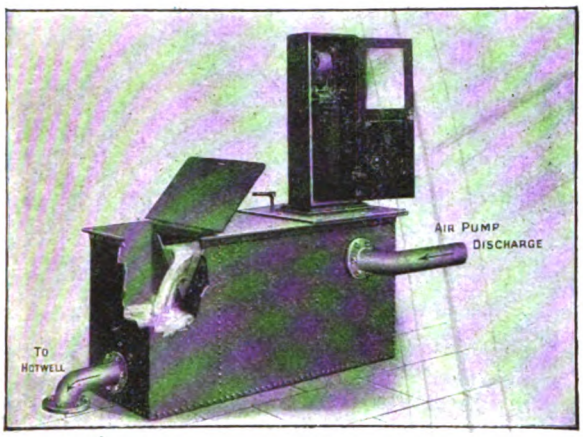


FIG. 2.—"LEA" SELF CONTAINED RECORDER.

Fig. 3 shows the general appearance of the instrument, although in the newest pattern the clock is inside the case. The action of the instrument is as follows. The recorder is actuated by the rising and falling of a float contained in a chamber beneath the instrument. This float chamber is in connection with the notch tank, through which the water to be measured is passed. The more the amount of water passing the greater the rise of the float. The float is connected by a rod to the instrument, and actuates a spiral drum through a rack and pinion. In addition a float rod indicates by a pointer the depth of water over the notch on the scale. The object of the spiral drum is to compensate the motion of pan, so that it moves equal distances for equal increments in the rate of flow. As the spiral groove is calibrated it provides a magnified scale from which very accurate observations of the rate of flow may be taken at any moment. This much of the motion is common to all the Lea Recorders. The special intergrating feature is worked by a powerful eight-day clock, which drives a vertical spindle, which in its

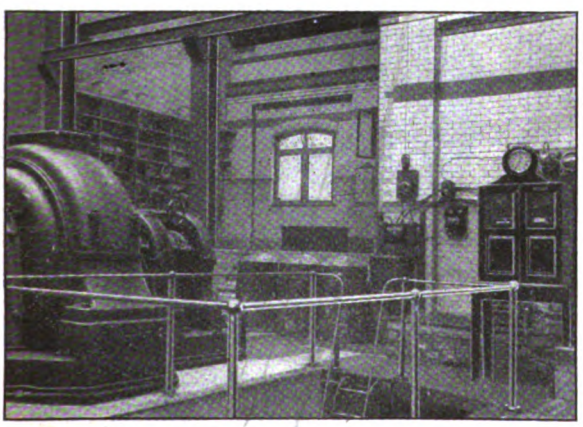


FIG. 3.—"LEA" RECORDER AT BURSLEM ELECTRICITY WORKS.

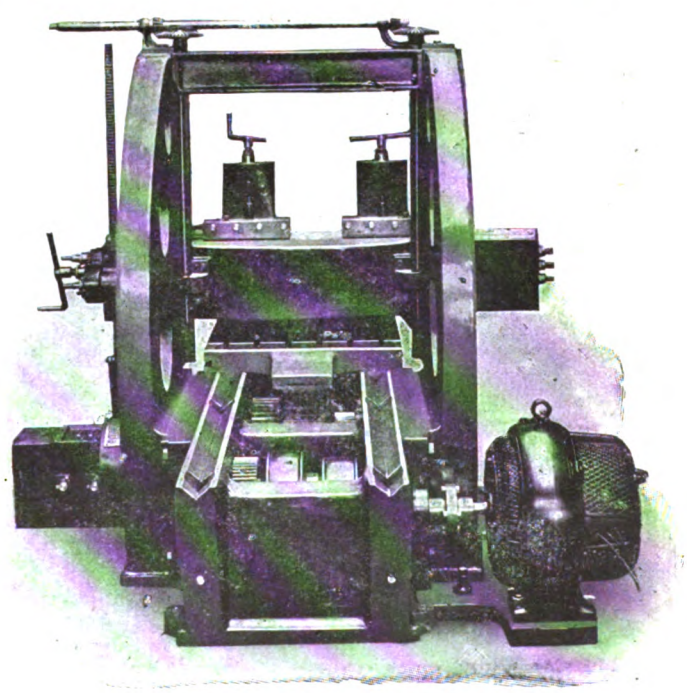
turn drives, through bevel gearing, the horizontal pivot-supported shaft, at, of course, a constant speed. Upon the axle is a toothed drum, the teeth of which are cut away in a regular spiral manner at the right-hand side. Above this toothed drum is the gear-box containing the counting train of wheels. This gear-box is driven by a pinion, which engages intermittently with a fewer or a greater number of teeth upon the toothed spiral drum, which, of course, is moved laterally to the right or left, according to the rising or falling of the float. The position of gear-box and pinion is determined by the amount of movement of a long horizontal slide-bar. If no water is flowing over the weir the instrument, of course, reads zero, and the toothed spiral drum is out of contact with the driving pinion of the counting dials. If the rate of flow is half the maximum, then the driving pinion is in contact with half the number of teeth. Thus it will be seen the drive is absolutely positive, and all the water passed through the weir must be registered.

The Recorder is, for the purpose of proving its merit, let out on hire, with the option of purchase, for special tests. It is to be hoped that those engineers who have not so far considered the advisability of making it part of their plant will take this opportunity of using a hired instrument and convincing themselves how necessary it really is.

Messrs. C. E. Lugard & Company, of Chester, are showing various types of electro-magnetic clutches and the "Pillow" flexible couplings.

The application of magnetic clutches for driving planing machines is shown on a Stirk no-belt machine to plane 8 ft. × 3 ft. square. This machine is fitted with variable speed drive, cut and return being independently variable. The table speeds may be changed whilst the machine is running by a patent controller, made by the firm, which varies the field of the motor. The motor runs continuously in one direction only, and the reversals are obtained by the double S.M. electro-magnetic clutch which is fixed inside the bed as shown in the illustration. This particular machine was specially built for the exhibition, but it should be noted that a special feature of this system of planer driving is that it can be as easily applied to an old machine as to a new one, and with almost the same results. The cost of thus speeding up an old planer is a mere trifle. As an example of the improvement which it can effect it may be mentioned that recently an old machine planing 5 ft. 6 in. × 16 ft., cutting at 25 ft. per minute and resting for 3½ seconds for the belt to come over, with a return of 35 ft., has been speeded up to give two cutting speeds of 28 ft. and 50 ft. per minute with a constant return of 60 ft. per minute and no appreciable rest after the stroke. This machine gives about 2½ times its former output, and heavier cuts can be taken even at 50 ft. with a reduced load on the motor. It is interesting to note that 11 cwts. of the old complicated gear were removed from the machine during the alterations.

The S.M. clutch is made of cast steel and consists of a stationary magnetic body with feet for fixing and containing an energising coil carefully wound and insulated for the particular supply voltage. The armature is divided and separated by a spring, one half being keyed to the shaft, and having a renewable friction cone of hard fibre or phosphor bronze (according to the conditions of drive), the other half having an accurately ground cone to fit, is loose on the shaft, and is provided with an extended



LUGARD'S "STIRK" PLANER.

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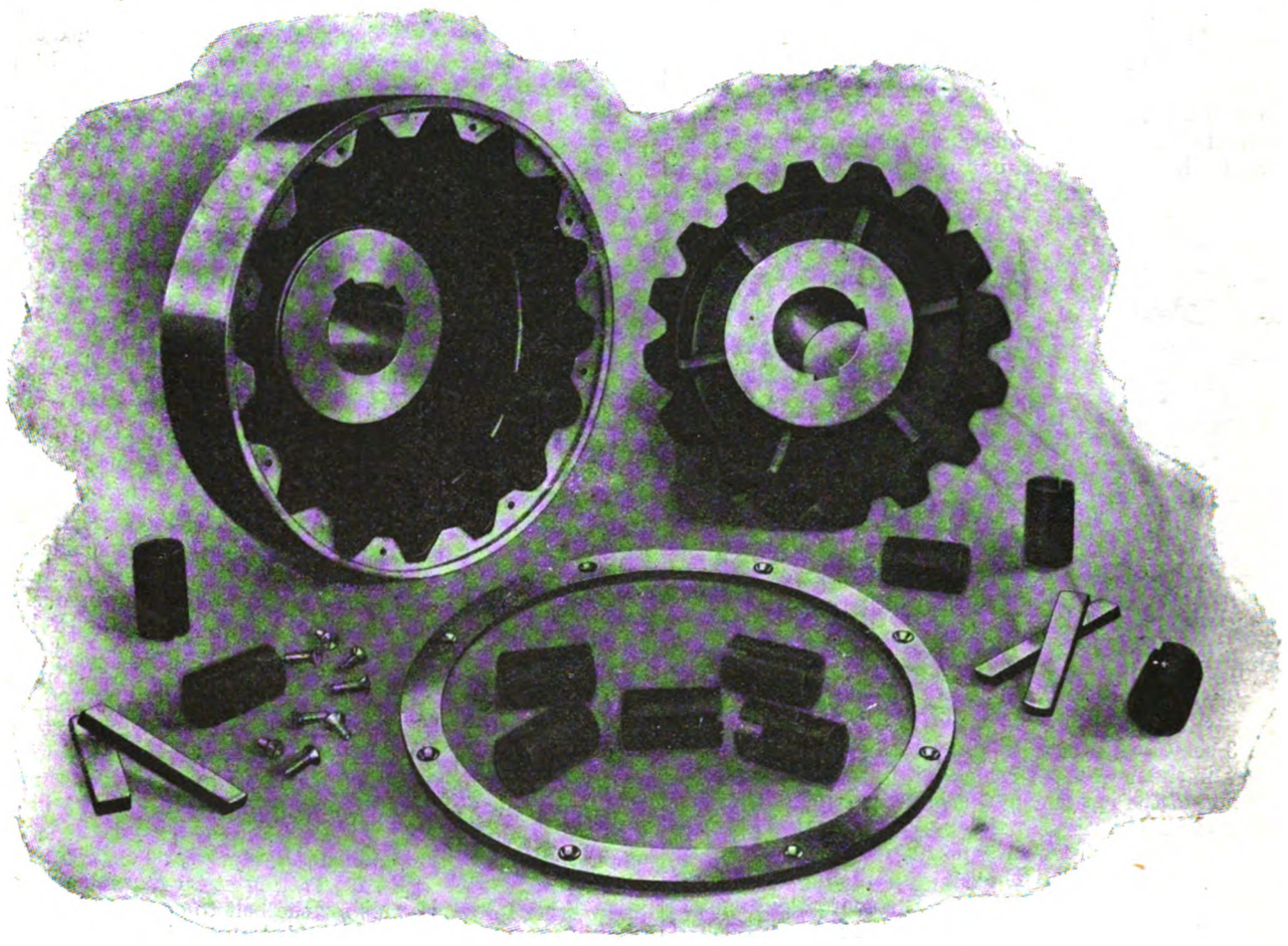
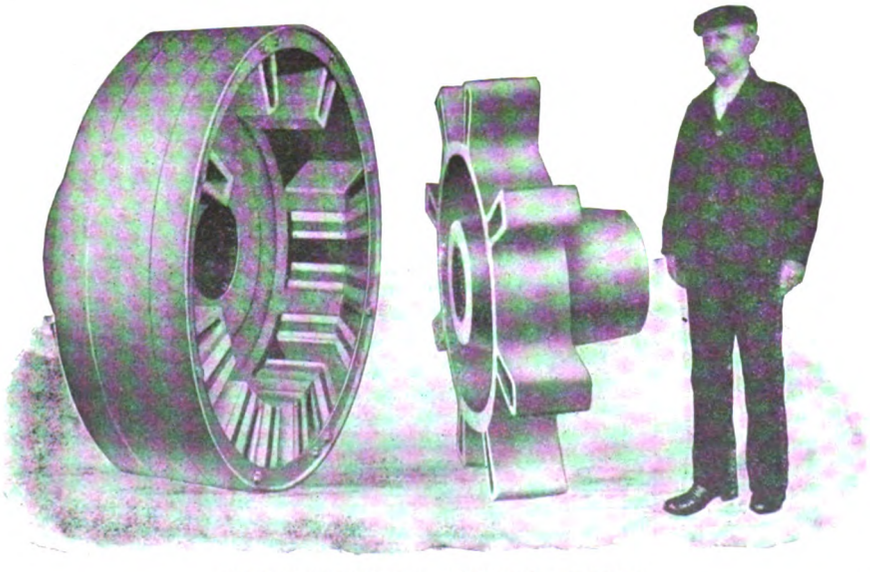


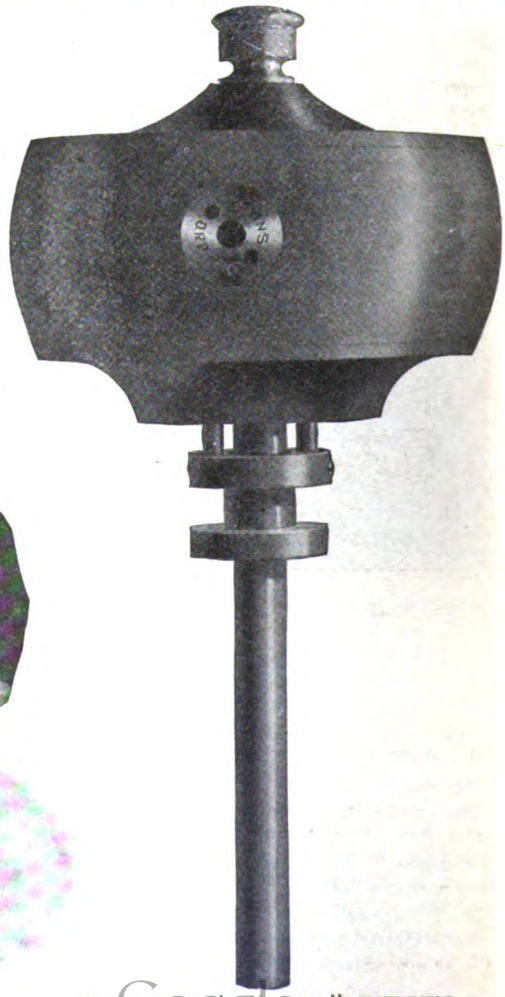
LUGARD'S "PILLOW" FLEXIBLE COUPLINGS.

nave to take a pulley or spur wheel. The accompanying illustration makes this plain. As the coil is stationary there are no slip rings or brushes. The whole apparatus is liberally designed and has a very long life. The divided armature is drawn together on the coil being energised, and the drive is thus partly magnetic and partly frictional. The clutch is designed for conditions impossible for the ordinary friction clutch. The S.M. type is successfully employed for rolling mills transmitting from 1,400 h.p. at 160 r.p.m. down to 400 h.p. at 300 r.p.m. Photographs and full particulars are to be seen at the stand. For transmission work this firm claims to have supplied the largest magnetic clutch in the world. This clutch, of their patent Vulcan type, transmits 1,000 h.p. at 75 r.p.m. and is 7 ft. 3 in. in diameter, weighing about 6¼ tons. It is working in Middlesbrough on a furnace blowing engine. They also show their "Pillow" Flexible Coupling. This is a very neat and simple coupling, and consists of two iron castings fitted together with steel springs. The illustration explains itself.

Messrs. Jens Orten-Böving & Company, who are so well-known in connection with water turbines and water power schemes, have naturally to content themselves with showing something not so large, although numerous photographs are displayed demonstrating work in these branches.



ORTEN-BOVING'S B.B. FLEXIBLE COUPLING.



ORTEN-BOVING'S "JAHNS" GOVERNOR.

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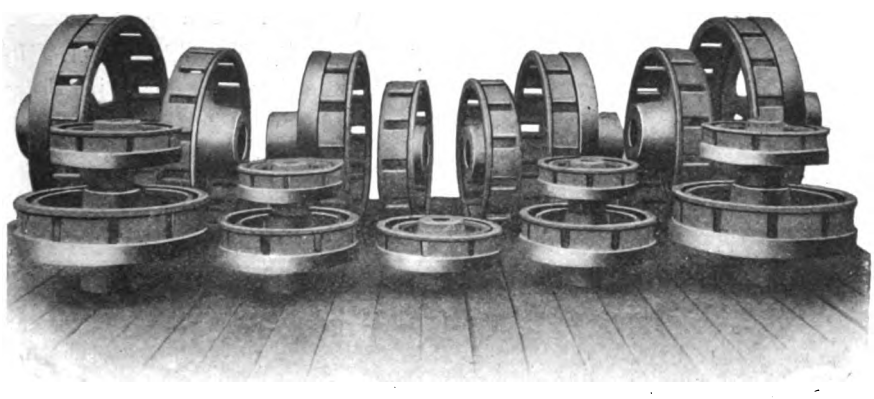
The actual exhibit consists of the Zodel-Voitt and B. B. Flexible Couplings, which are now well known and of which Messrs. Böving & Company supply several thousand a year. The Zodel-Voitt coupling consists of four separate parts:—An outer and an inner disc with suitable bosses; a rim bolted to the outer disc so that it can be detached in order to obviate the necessity of unlacing the belt if either shaft is to be removed; and a leather or cotton belt connecting the lugs on the outer rim with the inner disc. The advantages claimed are evenness in running, insulation, avoidance of strain to machinery from change in load, the counteracting of trouble from faulty alignment, preservation of bearings, and absorption of variations in angular velocity.

ORTEN-BOVING'S "HORN" TACHOMETER.

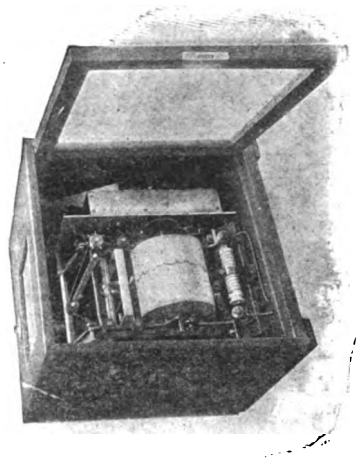
Among the other exhibits shown are some tachometers manufactured under Dr. Horn's patents. These instruments, which are illustrated here, are already well known and have the reputation of being the most accurate and carefully constructed instrument on the market, while the tachographs, which also form part of their exhibit, are used in large numbers where an exact record of the running of any machinery is required, and the instruments have been employed with great success in the testing of speeds on cotton machinery, showing up clearly the steadier drive of electric motors. Another exhibit worthy of inspection is the Jahns Governor. This is claimed to be the most sensitive governor on the market. Reference to the illustration (p. vii.) will show that the construction adopted justifies this claim. Every moving part runs in an oil-bath and friction is practically eliminated by the use of rollers.



ORTEN-BOVING'S ZODEL VOITT COUPLINGS.

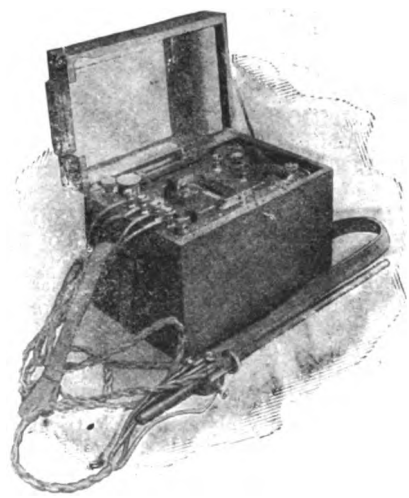
At the stand of Sutcliffe (of Crumpsall), Ltd.—which, by the way, is built of large sheets of red, grey and black fibre—a great collection of electrical fibre is to be seen, both in sheets, rods and tubes, and worked up into fittings and accessories of every kind. As has been previously pointed out, the works producing this material is situated at Manchester, and is the only one of its kind in Europe. In quality and finish, as well as in strength, both dielectric and mechanical, the fibre shown is equal to any of the American product, on which this country has formerly had to rely, and is better than most of it. The use of fibre is, however, being daily extended and already for many purposes it ranks among the metals, as well as competes with materials of the wood and leather varieties.

Other exhibits include blotting paper and sliver cans for textile machinery. These cans, fitted with the well-known Sutcliffe buffer-bottom, are produced at the Crumpsall works by special machinery, included in which is the finest pressing plant in the world, employed for pressing up the can bottoms from sheets.



THREAD RECORDER.

The stand of the Cambridge Scientific Instrument Co., Ltd., attracts much attention, for it presents a most comprehensive display of appliances appealing directly to both electrical and mechanical engineers. We select for illustration their Thread Recorder and Whipple Temperature Indicator.



WHIPPLE TEMPERATURE INDICATOR.

On the stand of André Citroën & Company are to be seen some huge machine-cut double helical gears for driving a spinning mill; also a set of large tube mill gearing. Several sets are running very sweetly and silently, driven by motors, one set being of high-reduction spur gears (single ratio 16 : 1).

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STEEL CONDUITS FOR ELECTRICAL WIRING.

The Engineering Standards Committee have just issued a revised specification for Steel Conduits for Electrical Wiring.

Owing to the obliteration of the inspector's stamp by the galvanizing process, difficulties have arisen in the practical carrying out of this specification. The Committee have, therefore, revised the clauses dealing with the Gauging of the Tubes so that they may be gauged after instead of before galvanizing. In order also to provide a better joint the length of the thread on the end of the tube has been slightly shortened so as to prevent the tubes butting inside the coupler.

The price of this specification (Report No. 31) is 5s. net.

NEW L.C.C. TRAMWAYS.

The London County Council have approved of the Highways Committee schemes for 22 miles extension of the electric tramways, at an estimated cost of £1,178,900. The extensions are from the Marble Arch to Cricklewood, Chalkfarm to Child's-hill, Kilburn High-road to Upper Avenue-road, Marylebone-road to Swiss-cottage, King's Cross-road to junction of Fulham-road and Elm Park-gardens, and Fulham-road to Brompton-road. In most cases the Borough Councils are opposing the schemes.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Under present conditions the placing of new work on the Tyne is extremely problematic, and the rumour which is going about that Messrs. Swan, Hunter and Wigham Richardson, Ltd., are to get an order from the Cunard Company for a bigger vessel than any liner yet constructed must be received with caution. The statements made, however, appear rather circumstantial, the length of the boat being given at about 1,000 feet, its speed 25 knots and its horse-power about 90,000. The report has been cold-watered by the chairman of the shipbuilding company, but the sapient ones recall the fact that the "Mauretania" was well under way in preparation before the order was officially made public. A more definite piece of information is that Messrs. Armstrong Whitworth & Company, Ltd., have secured the order from the Leith Dock Commissioners for the building of dock gates and machinery for that dock at a cost of £7,650. Whether electrical operation is to be adopted the writer has not been able to ascertain.

Colliery Work.

It behoves electrical engineers to watch colliery work at the present time, and some suggestions made to the Northumberland coal owners by their miners in order to meet the Eight Hours Bill deserve attention. The chief proposal is that the three-shift system should be done away with, and this suggestion is so far favourably received by the owners that they have promised to consider it carefully and report on the idea. It is needless to point out that hours of working have a very intimate connection with systems of haulage and other spheres in which electrical apparatus can be used for labour and time-saving purposes.

Municipal Work.

The large Town Hall at South Shields, mention of which was previously made in this column, has (last week) been opened, and the electrical illumination arrangements much admired. It is now stated that new municipal buildings to cost between £3,000 and £4,000 will probably be built at Ashington, and if the Local Government Board agree to a loan for the purpose there will probably be an opening for an electrical contractor.

Tram Extensions.

The negotiations to which reference has been already made between the Newcastle Corporation and the Newburn District Council have now been concluded, and the extension of the tramways in that direction may be considered as settled. The Corporation will, I understand, contribute one-third of the cost of road improvements, and will do the work. Furthermore, it will advance to the Newburn Council the amount required by it in connection with its portion of the cost, repayment to be spread over 30 years.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

One of the interesting points in the recent experience of the Birmingham Corporation Electric Supply is the increase in lighting consumption during the summer months. Curiously, it is in this department that the last quarter's returns show most favourably. This is taken as evidence that the diminution in lighting consumption recorded last year, attributed to the introduction of the metallic filament lamp, has been overcome by the rapid increase in the number of consumers brought about by the cheapening and improvement of the light. The total amount of power on supply does not show any very large increase over the September quarter of last year, but there is a steady increase in the number of small motors, and the hire scheme for motors is maintaining a steady growth. The tramway consumption is down owing to the introduction of meters, with which now practically all the cars are supplied. The economy which has been thus brought about is so great that if it should be continued a saving of something like £10,000 per annum on the city's tramway expenditure might be reckoned upon, but it is doubtful whether the new-born zeal of the tramway motormen for economy can be maintained at its present pitch. At all events, the installation of meters on the cars has, so far, completely justified itself from the point of view of tramway finance.

Show Room.

Much is hoped by the department from the new show room at the office in Dale-end. The show room is now fully stocked, and was opened on Monday. Circulars have been sent to consumers and possible consumers of current for power, announcing that a special exhibition and demonstration of power appliances will be commenced on November 1, and continued for a fortnight. A number of motors and controls, with tools of various kinds, will be specially installed during this period, and exhibitions will be given of electric welding and other operations incidental to the metal trades. A little later there will be a fortnight devoted to demonstrations of lighting, heating, cooking, and other domestic applications of electricity. The show room, as at present arranged, contains a large variety of electrical apparatus both for manufacturing and for domestic and general purposes.

Equipment.

In the power section, the current comes in at 300 volts three-phase, and goes through an Ellison oil switch down to a 5 kw. B.E. transformer, which transforms the current from 300 to 100 volts. The current is then conducted to a distributing board erected on an iron framework. The fuses on this board being cartridge fuses of the Siemens "Zed" type. From this board, the current is taken to one side of the room by a three-core cable to drive a shearing machine by Hands & Son, Birmingham, the motor being a 3 h.p. Siemens squirrel-cage. The feature of this drive is its compactness, the motor being behind the machine and the power being transmitted by means of a Hans Renold chain. A model rolling mill is driven by a 5 h.p. slip-ring motor of the Westinghouse type. This machine is a typical instance of the efficiency of electric driving. A tapping is taken from the main switch of the distribution board for single-phase current to supply a Prescot Welder No. 6, made by the British Insulated & Helsby Cable Company, Ltd. This has a 7½ h.p., 110-volt, single-phase motor, and is controlled by Ellison's time lags, giving cut-outs up to 10 seconds. The machine will make a weld up to a quarter of an inch in four seconds. Near at hand is a breast-drill, by the Electrical Ordnance & Accessories Company, Cheston-road, Aston, driven by a motor of ½ h.p. A smaller tap is taken to supply the current for lighting the bay containing power section. The lighting is done from four points, and various kinds of lighting are illustrated, among them the "Milns" fitting, named by the manufacturers (the General Electric Company) after the Superintendent of the commercial and consumers' department, and designed for factory lighting by means of incandescent lamps of high candle-power grouped under a reflector. On the other side of the power section a current supplied at 220 volts direct is used to drive a bandsaw, a Phœnix grinder, a Thwaites blower, and an Archdale high-speed drill, the motors being supplied by the Electro Motors, Ltd., the Phœnix Company and the British Thomson-Houston Company. Several varieties of starter and double-pall switch are included in the exhibition, among the types represented being the British Insulated & Helsby Cable Company, the Adams Manufacturing Company, Dormans, and the Ellison rheostat starter.

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GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The Berlin Fire Brigade have adopted a new safety plug invented by M. von Eicken for preventing explosions. The plug is intended for use in places where explosive mixtures of combustible gas and air are likely to occur, such as garages and dry cleaning establishments. The construction is such that the igniting spark is made in a space fully protected by insulating material from the surrounding atmosphere. In a trial of the invention by the Konigliche Materialprufungsamt the apparatus was made to act 5,370 times in a closed chamber filled with an explosive mixture of air and benzine vapour without any explosion occurring.

The brigade now possesses 24 automobiles, including four electric fire engine trains of four wagons each, one electric practice carriage on the Lohner Porsche system, a 45 h.p. petrol-car for the chief officer, and six petrol cars for superintendents. The use of automobiles in general has proved very satisfactory, but exact statistics as to the expense of maintenance and working are not yet fully made out. Electric motor-cars seem very free from danger of catching fire. During 1909-10, out of 46 cases not one was connected with an electric car. Electric cars are, of course, few in number compared to petrol cars. Some interesting observations were made by the brigade with regard to the risk of explosions with petrol or benzine. According to one authority there is danger only when the benzine vapour forms between 2½% and 5% of the total atmosphere, a composition that cannot exist more than 20 inches above the ground. Hence it has been made a rule that in large garages safety plugs must be at least five feet from the floor. As regards fire alarms, the system of lighting gas from a distance has been found wanting. It often happened that the gas was not lit and escaped to a dangerous extent. Hence an electric system with incandescent lamps has been fixed upon. In the year the brigade dealt with 8,288 fires, out of which 23 were caused by defects in electric installations.

New Incandescent Lamp Socket.

The usual protection for the screw, namely, a porcelain ring, has the drawback of easily getting loose and being readily broken, when the current is apt to get to the metal shield and give a shock to any one earthing it accidentally. To remedy this the Ex Officio Beleuchtungskörper Compagnie of Wiesbaden substitutes for the porcelain ring a bell-shaped glass, which is screwed into the shield and is completely insulated from the contact piece. The shield is in three parts, and all conductors are embedded in insulating material which is not likely to break or work loose. The glass bell can also be used as a reflector.

Proposed New Electric Railway.

The towns of Cologne and Cassel are considering a plan for having a normal gauge electric railway between them to be made by the Bergmann Elektrizitatswerke. Towns in Westfalen and Waldeck, through which the line would pass, are willing to supply land gratis. It is, however, doubtful whether the Prussian Government will sanction the project, for the attitude taken up by the Minister of Public Works must be borne in mind. So far as undertakings of this kind are of local significance only no objection is raised, unless they compete too much with already existing railways under State control. Thus, although there was a previously existing State electric railway between Cologn and Bonn, railways between Cologne and Dusseldorf, railways between Frankfort and Wiesbaden were allowed. But the case is quite different with lines which can be used for general intercourse, and must therefore be regarded as additions to the already working State-system. Hence the Cologne-Cassel line will probably be prohibited, as that between Dortmund and Dusseldorf was. If such a railway is wanted, well and good, but the State must construct and run it. The Minister, judging by the evidence at present at his disposal, is by no means satisfied that there is any urgent demand for the proposed undertaking. A final decision will no doubt soon be made.

Electric Iron Smelting.

The latest steel-furnace is that of Nathusius, which is an attempt to combine the advantages of the Heroult and Girod furnaces. In the Heroult furnace two carbons pass through the roof and the arc between them passes over the surface of the bath of metal. In the Girod furnace the current passes through the metal, between a pole entering the furnace from above and another entering it from below. In the Nathusius furnace there are two groups of three electrodes each, the current passing as in the Girod furnace. A rotary current is employed. Hence in both groups the current flows horizontally from electrode to electrode as in the Heroult furnace, because it forms a rotating field, but must also flow to a point of junction in the middle of the bath of metal as the current does in the Girod furnace. Hence the metal is heated both superficially and internally. There is the further advantage in using a rotary current that it can be taken direct from the main without transforming.

Company Notices.

The Deutsche Gasgluhlicht A.G. has made vast strides during the last few years. The net profit for 1909–10 is 6,238,697 marks, as against 4,038,199. The preference shares get a 5% dividend on their 6,600,000 marks, but the other shareholders get 50% on what is the same capital. Hence plenty of money remains and 2,200,000 marks are devoted to creating a special reserve fund. What is left is either carried over (38,697 marks) or paid as directors' remuneration (100,000 marks), or used for sundry small costs. The report is noteworthy chiefly for two things; one is that a lowering of the prices obtainable has increased the output, presumably to an extent which compensates fully for the loss in price. The other point is that the Osram lamps made by the firm have had an extensive sale, which is still increasing, despite competition of newer types. It is proposed to issue another lot of preference stock at the same rate of 5%, and at the same amount of 6,600,000 marks. It will perhaps be worth while to buy these, as the ordinary shareholders are not likely to sell at present.

The Zwickauer Elektrizitatswerk und Strassenbahn A.G., has decided to increase its capital from four to six million marks, as it is rapidly buying out all the rival companies. When it has done the work at present in hand it will be supplying a scattered population of about 170,000 with electric light and power.

The Danziger Elektrische Strassenbahn, A.G., made a gross profit for 1909 of 669,768 marks, but the net profit, after deductions for preference shares, depreciation, etc, was 301,128 marks (297,270 in 1908). The dividend on the ordinary capital of 4,300,000 marks will again be 6½%.

The Moore Licht und Elektrizitats G.m.b.H., of Cologne, has raised its capital from 340,000 to 373,000 marks.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Mr. Thomas E. Murray, President of the Association of Edison Illuminating Companies, in the course of his address at the recent Convention of that body, drew attention to the large field presented in dock and quay work for the utilisation of electrical energy. At the Robins ship-repairing and dry dock at Eric Basin, Brooklyn, the steam-plant aggregating a rating of approximately 2,000 h.p. has already practically been displaced by electric power with complete success. Current is taken from a central station at 6,600 volts, three-phase and 25 cycles, the dry dock company operating its own transformers for low voltage energy for small motors. Energy was first applied to the operation of a new 6,000 ton pontoon floating dry dock, each set of ten 12 in. centrifugal pumps, one each side of the dock, being operated by a Western Electric Company's 300 h.p. motor, running at 485 r.p.m. through a horizontal line shaft running, like the pumps, at 250 r.p.m. By inserting resistance in the armature circuit by means of slip rings a wide variation of speed, from 10% to full, is obtained for

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the motors. The full capacity of the dock requires the handling of 10,000 tons of water and the pumping is accomplished in 30 min. This experiment having proved so successful, the same form of energy was applied to a 4,000 ton balanced floating dry dock which was built more than 50 years ago. The boilers and engines were replaced by two 100 h.p. motors operating at 450 volts, 470 r.p.m. on each wing, each motor driving a set of three pumps 36 in. in diameter with 30 in. stroke, and the dock is pumped in 90 min. The motors in this case were made by the Wagner Company, and the drum controllers by the Westinghouse Company. Electricity was then applied to the air-compressing plant—probably the first in the world to be driven by high-tension motors. It is composed of two units, each of 2,000 cubic ft. capacity per minute. It operates at 145 r.p.m. and is driven by 6,600 volt motors current being brought by underground conduit to a switchboard provided with oil-switches and overload, time relay, circuit breaker in the armature circuit, each unit giving 360 h.p. at full load. Both motors and controllers were in this instance supplied by the Western Electric Company. As in both the other applications outlined, not the slightest trouble or interruption has been experienced with the electrical operation of this plant. In addition to this electricity has been applied with equal success to the graving dock plant, operated by two General Electric Company's 350 h.p. motors, while the workshops are also electrically operated with motors ranging from 10 h.p. upwards. Meanwhile a 6,000 ton sectional dry dock is being equipped with twenty 20 h.p. motors and two of 50 h.p. Motors aggregating 2,774 h.p. are already at work throughout the docks and the energy consumption is computed at 263,200 kw.-hours per month. A detailed and fully illustrated description of this electrical equipment given in the current issue of the "Electrical World," is well worth the attention of readers of the ELECTRICAL ENGINEER.

Ventilation of Electric Cars.

A good deal of attention was devoted at the third annual Convention at Chicago of the Association of Railway Electrical Engineers to the question of car ventilation—a problem which neither in this country nor in England has yet been satisfactorily settled. Apart from variations of temperature according to the season of the year, it seems in good weather as difficult to steer an effective middle course between a dangerous draft and an equally dangerous accumulation of carbonic acid, as it does, in cold weather, to warm a car without overheating it. In a paper read before the Convention, Mr. B. A. Stowe, the Chief Engineer of the Jandus Electric Company of Cleveland, urged a supply of 3,000 cubic ft. of pure air for each passenger per hour, whereas it has hitherto been generally conceded that 500 cubic ft. is sufficient. There is a very wide discrepancy between these figures, but the crux of the problem appears to lie in the choice of methods of diluting the exhaled carbon dioxide and generally speaking, it is agreed that the fan-exhaustion of foul air at the top of the car is a necessary auxiliary to the regulated influx of fresh air. Mr. Stowe's proposal is the adoption of 9-in. direct current exhaust fans in the back of the deck sash communicating with discharge flues carried over the car roof. These fans, he said, should be wired on two multiple circuits, one on each side of the car, so that either or both sets of fans can be used in accordance with external conditions. Such a fan, he calculated, could displace 530 cubic ft. per minute, and if a 12-in. fan were used, it would displace 1,100 cubic ft. per minute. General agreement was expressed with Mr. Stowe's paper by other speakers at the Convention and it seems to be conceded that since the provision of an exhaust van is a simple matter and not very costly, it is imperative that it should be adopted.

Causes of Electrical Accidents.

The notes of an Accident Insurance Company's engineer on a number of electrical casualities during the past year, which are summarised in the current issue of the "Electrical World" of this city, afford some useful and instructive lessons in the care of motors and generators. Of the accidents reviewed—the total number is not stated—40% in the case of generators and 39% in the case of direct current motors resulted from defects in armatures or rotors, and faults in commutators came next in order. In the case of alternating current motors rotor troubles caused 23% of the accidents and stator coils 49%. In the case of a 250 kw. 500 volt d.c. generator running at 375 r.p.m. the engineers on watch saw flashing with solder thrown from the commutator lugs. For some hours no cause could be found for this, but eventually some solder was found to have been melted out of four commutator lugs and wedged in behind them, the cause of all the trouble was found in the shape of a ferrule from a file. In the case of a 500 volt motor which caused short-circuiting and of another which caused fuse blowing, it was found that mice had crawled into the armature during the night to enjoy its warmth and had been flung to the outside of the cavity behind the armature lugs when the motors started in the morning. A guard of fine wire netting over the end plates effectually safeguarded the motors against the recurrence of a mishap from this source. Investigation into a long series of troubles with a 440 volt three-phase motor of 120 h.p. resulted in the discovery after many other possible sources of trouble had been looked into, that the bearings were defective, the upper halves of the brushes having been so worn as to allow the shaft and rotor to be forced into contact with the stator by the pressure directed by the teeth of the driven wheel upon those of the pinion on the end of the rotor shaft. In the operation of a 350 h.p. three-phase motor with a frequency of 50 cycles and supplied from a service of 11,000 volts, repeated failures of the stator coils occurred. A damaged coil, the cotton covering of which was found to be bleached, dyed green, and badly decayed, was tested and nitric acid was found to be present. This had been formed by decomposition of the air by brush discharge from the high-tension conductors and had thus destroyed the insulation. Failing the reduction of brush discharge by restricting the conductors in each slot of the stator to a single row, the report on this case declares that the only method of preventing trouble is to insulate the conductors completely from air and moisture; but this is admittedly extremely difficult.

House-Lighting by Storage Battery.

A noteworthy experiment in house-lighting by means of a storage battery has been successfully carried out in Chicago in the West Side home of Mr. J. Haschke. He has installed two portable 6 volt 60 ampere-hour batteries of the Jewel type, one of which is connected to fourteen 6-volt tungsten lamps of candle-power varying from 2 to 10. The battery is also linked up with spark-coil to ignite the burners of a gas-stove in the kitchen, and with burglar alarms, call bells, electric fans and electric cigar-lighters. The second battery operates a vacuum cleaner, a sewing machine, a massage vibrator, and an electrically energised table-fountain. One or other of the batteries is recharged once a fortnight at a cost of 15 cents, the total annual cost of re-charging being thus $3.60 cents—say 15s. a year.

Electrical Separation of Minerals.

Announcement is made of the fact that Mr. G. W. Pickard, Electrical Consulting Engineer to the Huff Electroslatic Separator Company, has, after careful practical experiment, prepared a list of 221 minerals which can successfully be separated by electrostatic means. The announcement is one of considerable importance to mining engineers, and its commercial value is enhanced by the fact that Mr. Pickard, in the course of his researches, has discovered simple and easily practical methods by means of which such metals as normally possess little conductivity can be rendered readily susceptible of electrostatic separation. When, for instance, resinous non-conducting zinc sulphide is treated with a very dilute solution of copper sulphate and then dried, the necessary conductivity is easily imparted to it, while in the case of limonite iron ore, roasting has precisely the same effect. It is interesting to note in this connection that the Huff Electrostatic Separator forms the subject of a communication to the "Electrical World," in which Mr. H. A. Wentworth describes some of its performances and traces its evolution. The problem was how to keep a metallic surface insulated while charged at a potential of 50,000 or 60,000 volts while simultaneously supplying that surface with a stream of particles of which a large portion might be excellent conductors, and Mr.

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Wentworth observes that with the dust, dirt and moisture of the average mill, the problem proved a very difficult one. Its solution came in a combination of the grounded metallic surface with an electrode placed opposite, thus forming an electrostatic field whose intensity could be varied by changing the distance between the surfaces and altering the potential difference applied—a combination which permits the use of metal for all the wearing parts of the machine. This is the principle of the Huff separator in which a potential of from 18,000 to 40,000 volts is maintained between the electrodes. That it is effective is proved by the experience of the American Zinc, Lead and Smelting Company at Platteville, Wisconsin, where 80 tons a day of blende and marcasite concentrates are successfully separated by the electrostatic plant, and similar results are recorded in other mills.

The Inventor of the Motor.

The recent joint Convention of the New England Section of the National Electric Light Association, the Vermont Electrical Association, and the Vermont Historical Society was made the occasion of unveiling a tablet to the memory of Thomas Davenport, "the Blacksmith of Brandon," who at Forestdale, near Brandon, Vermont, sixty-six years ago, built the first electric motor which the world had ever seen. In the presence of a noteworthy gathering of Davenport's descendants and of distinguished electricians, the tablet was unveiled by Miss Frances Davenport, his grand-daughter, and Mrs. A. J. Campbell, wife of the President of the New England Section of the National Electric Light Association; and an eloquent eulogy of the famous inventor was pronounced by Mr. T. Commerford Martin. He referred to Davenport's humble circumstances, meagre education and lifetime of struggle; to his absorbing interest in the Henry galvanic magnet, to the flash of insight which revealed the availability of power from an electro-magnetic source, to the pathetic sacrifice by his young wife of her silk wedding dress to supply insulating material for the building of the motor, and to the final triumphant realisation by Davenport of his ideal. Though Faraday and Henry had already done their great work, said Mr. Martin, there were no real motors before that of Davenport upon which so mighty an industry had since been upreared. "His record," he said, "is astounding and unimpeachable. Struggling against adversity, dying in poverty, and long obscured by forgetfulness, this modest simple son of Vermont stands forth as conspicuous as one of her granite mountains among the immortals who for the benefit of their fellow-men have tamed and utilised the lightnings of the Almighty."

New Type of Railway Motor.

In the new Bulletin of the Allis-Chalmers Company a new type of railway motor is announced, for which it is claimed that it embodies not only the ideas gained by years of manufacturing experience, but that it has been evolved in the light of actual practice. Both in the matter of design and construction the keynote of the new motor is simplicity, the main object aimed at being the effective elimination of all the customary sources of trouble. In this new motor, which is listed as Type 302, the field frame is of cast steel and is split horizontally through the armature and axle bearings. It has a large bore at each end to receive the armature bearing housings. An opening in the top half over the commutator and hand holes at each end of the bottom half are provided for inspection of the motor. The top half carries the axle bearings and lugs for the cross bar suspension. This motor has a nominal rating of 55 h.p. at 500 volts based on a rise of temperature, by thermometer, not to exceed 75° C. above the surrounding air when run for one hour on shop test at rated load and voltage. It has a continuous capacity of 50 amperes at 300 volts and 45 amperes at 400 volts with a temperature rise as given. A two-motor equipment will operate cars weighing 25,000 lbs. without load or electrical equipment on city and suburban service at a schedule speed of approximately 11 miles per hour and a maximum speed of about 30 miles per hour. A four-motor equipment on inter-urban service will operate cars weighing about 35,000 lbs. without electrical equipment or load at a schedule speed of about 24 miles per hour and a maximum speed of about 40 miles per hour. These schedules and speeds are based on straight and level track and 500 volts line pressure.

EDUCATIONAL.

DARLINGTON TECHNICAL COLLEGE.

Darlington Technical College has been provided with an exceptionally fine and well-equipped engineering laboratory, and on the occasion of its inauguration last week the Principal, Mr. J. Scholes Hughes, was able to report very favourably of the progress made on the institution. Subsequently the Hon. C. A. Parsons, C.B., F.R.S., gave an interesting address on the advantages of good laboratory training. He remarked that in the early part of last century engineering was principally guided by traditional rule and trade knowledge, handed down from father to son, and from master to apprentice. In recent times, when engineering had gradually assumed a more important place, its field of operations had become wider and more complex, and it had become imperative to institute, instead of the old and primitive methods, systematic technical training of the young. There was probably no field of work in modern times where so great an amount of well-ordered experimental investigation had been undertaken as in engineering. Advance in engineering was necessarily slow and tentative, and the great general course of advance was one of gradual evolution. Turning to the advantages of technical and engineering schools and workshops, he emphasised the fact that knowledge, more especially of the practical side, was a kind that must be acquired when a man was receptive, and at such an age when ideas and impressions then acquired became so ingrained as to constitute intuitive and guiding principles in after life. In the engineering laboratory the students were brought face to face with materials and machinery for dealing with them and for discovering their characteristics. All these things were explained to the student, who could verify them for himself with his own eyes and head. In such a surrounding he gradually acquired a familiarity with practical engineering, and the power, so to speak, to think with engineering materials, and to form a mental picture when he tried to design a new or improve an old machine, or design new methods of work. Such a training would fit a student to go out into the world with mind and eyes alert, and ready to acquire more knowledge, and fit him to command success in most branches of engineering. By the help of good technical training there was no doubt that a very much larger proportion of men of high standard were produced than would be the case without it—men of knowledge, capable of taking the lead, capable of commanding, and who would deal fairly with their subordinates. It must be a source of gratification to all who had those objects in view, to feel that in that college they had such an admirable and carefully-selected equipment, and he was sure the authorities deserved to be most sincerely congratulated. He had looked through the list of their apparatus, and so far as he could see there was no problem in engineering which could not be demonstrated to the students in that laboratory. He impressed upon the students that there was no royal road to success. Hard work and diligent application was as necessary to the man of exceptional ability as to the man of moderate ability. There were few men too poorly gifted to succeed provided they applied themselves assiduously to work. They must not think when they left college that they knew everything. They must realise that they had been started on the right road, and that they would have to go on learning so long as they continued to work at engineering.

PERSONAL.

Mr. J. H. Rider, M.I.E.E., late of the London County Council, is now in Johannesburg, where he has gone on special service for Messrs. H. Eckstein & Company.

Mr. Alexander M. Gray, of Edinburgh, has been appointed Assistant Professor of Electrical Engineering at M'Gill University, Montreal. Mr. Gray, who was apprenticed to D. Thomson, Ltd., Edinburgh, is a B.Sc. of both Edinburgh University and of M'Gill University, graduating in the latter with honours in six subjects, and winning the British Association medal and prize.

Mr. G. Basil Barham, A.M.I.E.E., who has been for a short time engaged upon other work for his firm, has again taken over the management of the Publicity Department of the Edison & Swan United Electric Light Company, Ltd.

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Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

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LONDON'S ELECTRICITY.

In the present year of grace the amount of electricity generated and consumed in London is enormous, but it is little more than a tithe of what the demand may reasonably be expected to be in, say, about a couple of decades. It is true that for the moment London's and Greater London's 76 generating stations have plant capable of providing a bigger supply than there is an actual demand for, owing to the influence of the metallic filament lamp. But this is merely a temporary set-back, which, indeed, is likely to stimulate demand, partly by inducing more householders to avail themselves of a cheap and well-nigh ideal illuminant, and partly by causing new outlets to be sought for and found. The temporary set-back, then, is likely to be followed very shortly by the need for extensions, as we have recently witnessed in the Easterly districts. Therefore, the question raised by Mr. John Burns, M.P., President of the Local Government Board, and by Mr. Robert Hammond, M.I.E.E., as to the wisdom of having a central generating station becomes one of immediate importance. Mr. Burns, speaking at the recent Town Planning Conference in that wide spirit of civicism which we have learnt to expect from him, lamented the fact that a few bustling, misguided artists had succeeded in stopping the westward progress of the Embankment, which had, as its immediate consequence, the erection of the hideous electric generating station, thus spoiling a splendid vista. He added that in his opinion the station would have been better situated at Barking. Mr. Robert Hammond, both on æsthetic and economic grounds, commends this view of the matter, and

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he thereupon laments the fact that three Bills giving powers for the erection of central generating works at Barking, whence bulk supply would have been made to the 76 existing stations as sub-stations, and to any new sub-stations, had been rejected by Parliament. He reminds us that the last Bill, promoted in 1908, passed the House of Lords Committee, but was rejected by the House of Commons Committee. He says that as a leading Cabinet Minister endorses this policy of central generation of electricity for bulk supply to distributing authorities, it is time either that a company should be allowed to carry the work through, or that the London County Council should be allowed to do so, or—we presume, on the plea of the Imperial position of the Metropolis; that the Government should provide national funds for the undertaking. No doubt, as both Mr. Burns and Mr. Hammond say, the policy of central generation is the ideal one in every way. But in advocating this it should be clearly understood that municipalisation of the bulk supply is the only possible means of attaining the object aimed at. The days have passed when it is possible for a private company to be entrusted with such a gigantic enterprise, which so directly concerns the well-being of so vast a population and many material interests. The full benefits of central-station generation such as foreshadowed above could only be realised if at the same time the immediate or gradual extinction of the 76 scattered generating stations was provided for. Now, it is conceivable that existing trading companies might agree to some form of amalgamation, or some working arrangement whereby they would cease to be producers, and merely become distributors of electricity. But it is quite certain that such a fate would be scorned by the Metropolitan boroughs and most of the public bodies constituting Greater London. They would fight for autonomy, and the only way of breaking down their opposition would be by appealing to the greater good of the greater number, the welfare of London as a whole. It would be impossible to forbid the various public bodies erecting new or extending old electricity generating works and forcing them to go for bulk supply to a company run for private gain. On the other hand, it would be quite within practical politics to set up a public body for generating electricity and compelling other public bodies within a given area to seek for supplies, within a reasonable time, from such central body. We are not for the moment advocating this drastic step. Our concern at this juncture is to point out that central generation of electricity for London must inevitably mean municipalisation in one guise or another. Those who are inclined to applaud Mr. Burns and Mr. Hammond for their *obiter dicta* on this matter should clearly understand whither they are tending.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

QUESTIONS.

Question No. 1233.—Explain briefly why the efficiency of commercial lamps (electric) is so low? State ratio of best present efficiency to theoretical efficiency, and indicate the most hopeful means of improving the former. Does luminescence seem likely to become valuable? What is meant by selective radiation? Distinguish between arc lamps and vacuum tube lamps (electrically) and comment on the value of arc lamp equations.—"Tap."

Question No. 1234.—Explain the theory, construction and use of diffusometers in the photometering of various lamps. State the limitations of the apparatus (inherent and practical). I think of using a cubical form instead of the usual sphere, how will this affect results? Will secondary standards be necessary? Comment on the use of translucent screens in photometry (especially in the measurement of high candle powers).—"City."

ANSWERS.

Question No. 1228.—Describe the working and give diagram of connections of two-wire continuous current generator with static balancing transformer. How does this arrangement compare as regards cost and efficiency with the ordinary generator connected across outers, middle wire being derived from separate rotary balancer?

Reply to Question No. 1228 (*awarded* 10s.).—The means by which a "neutral" point (for the third wire connection) may be obtained, by the application of auxiliary two, three or four-phase connections to any closed circuit direct current armature, are shown in Figs. 1a, 1b, 1c. For the purpose of creating the neutral point, the armature then acts as a two, three or four-phase mesh connected alternator (alternating current being, of course, generated in all continuously wound armatures precisely as in mesh wound alternators). The several phase points P, P', P", etc. (uniformly spaced round the armature winding), being connected to corresponding arms of a star wound choking coil, yield the neutral point B in the several cases. The windings of the armature and choking coil being uniform and the electrical and magnetic conditions being symmetrical, it follows that the potential of the point B is always midway between those of the points AC, *i.e.*, B is a suitable point to which to connect the neutral or middle wire of a three-wire D.C. distributing system.

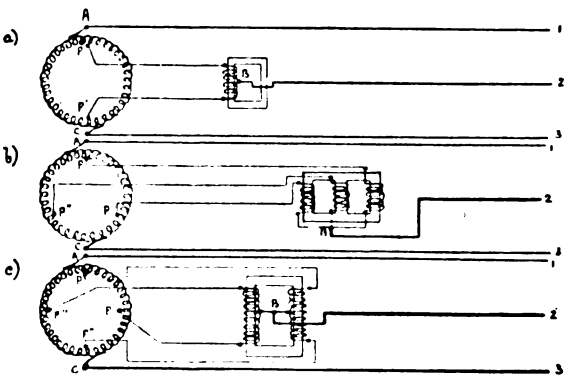

Fig. 1.

Tapping alternating current from the armature to excite the choker, in no way interferes with the obtaining of direct

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current from the main brushes AC. As in convert rs, however, the auxiliary armature connections cause local heating of the windings to reduce this effect, the number of points P, P'—should be greater than two. The three-phase connection (Fig. 1b) is open to the objection that heavy circulating currents may be set up in the windings if third harmonics be present in the wave form of the a.c. armature current. The main E.M.F.'s in the three divisions of the winding balance all right, but the third harmonics are completely additive in effect. The four-phase connection of Fig. 1c (Westinghouse) is very economical, smooth in action and generally advantageous.

With a well-designed and built choker, the alternating current traversing it is practically wattless and the loss

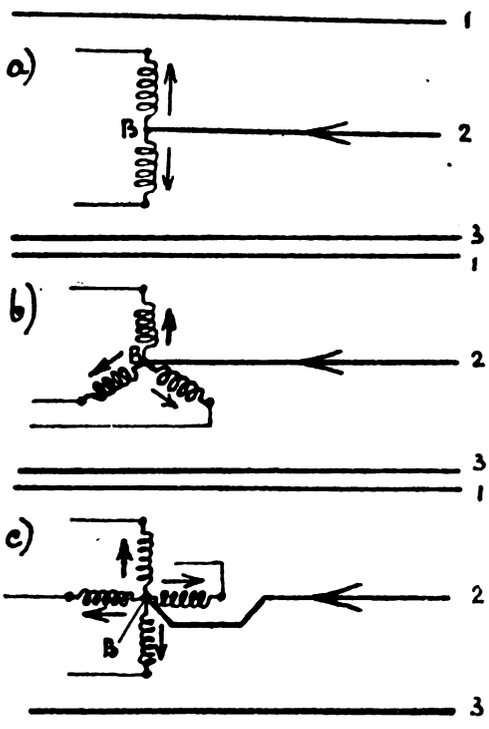

FIG. 2.

of energy from this cause therefore small. Normally (or rather under ideal conditions) there is no current in the middle wire of a three-wire system, but when, as is invariably the case in practice, the two "sides" of the total load are imperfectly balanced a certain balancing current (positive or negative) flows in the centre wire to equalise matters. Such a current traverses the various coils of a static balancer as shown in Figs. 2a, 2b, 2c, producing no resultant magnetic effect and, since it is a continuous current, no inductive drop.

In rotary converter stations employing star wound transformers, the neutral point B, which had to be specially provided in the above instances, is already to hand. As shown in Fig. 3, the neutral point of the low

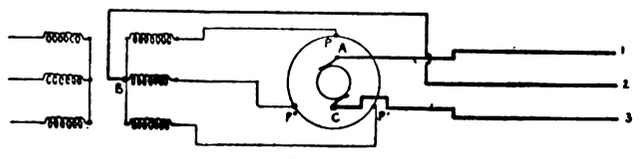

FIG. 3.

tension transformer windings is precisely similar to that provided by the three-phase choker of Fig, 1b. The "outers" of the three-wire system are connected to the d.c. brushes of the convert r, the "middle wire" being connected to the neutral point B (Fig.3). If mesh connected transformers are used a three-phase choker is again required to produce the neutral point.

A considerable disadvantage of the static balancer, applied as above, is that it is impossible to raise the voltage across either half of the system above *V* volts (to compensate for the extra pressure drop on the more heavily loaded side). To overcome this objection a series booster may be placed in series with the middle wire (Fig. 4) and so connected as to always aid the overloaded side of the system. Some of the low capital cost otherwise possessed by static balancers is thus sacrificed.

Twin generator sets, in parallel with a battery of secondary cells connected across the outers, probably form the best means of supplying a d.c. three-wire system when the k.watts demand justifies the use of two main generators. Otherwise a single generator and static balancer *or* battery of secondary cells with adjustable "centre" connection to the third wire (to permit of adjustment to suit unbalanced loading) forms good practice. In most stations independent auxiliary booster machines are used for balancing purposes. Such plant will seldom stand large out-of-balance loads, and in this respect a static balancer shows to advantage.

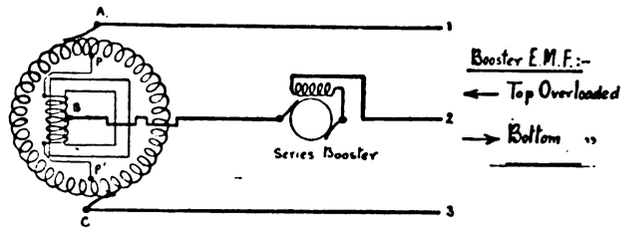

FIG. 4.

Static balancers avoid the use of special balancing motor-generators and often enable a single main generator to be employed where two would otherwise be required. Capital outlay, operating costs and floor space are all reduced by the use of the static apparatus. The latter is usually more efficient than rotary balancers in moderately small installations. In large systems, however, the static balancer is less advantageous; its higher efficiency is reduced. if not eliminated, and its advantages in capital cost and space occupied are correspondingly removed, in fact, the static plant is best confined to comparatively small installations.—"TAP."

Answer to Question No. 1228 (*awarded* 5*s.*).—The working and connections of a static balancer are in most cases very simple. The simplest arrangement for a single two-pole dynamo with three-phase balancer is as shown diagramatically in Sketch No. 1.

The dynamo armature is fitted with three slip rings by which connection is made from points equally spaced round the armature windings to the ends of three choking coils connected in star.

The middle wire is taken straight from this star point and neither switches nor fuses are usually placed in this circuit. When only one balancer is provided for several generators a triple pole change-over switch is required, but a common arrangement is for each dynamo to have its own independent balancer.

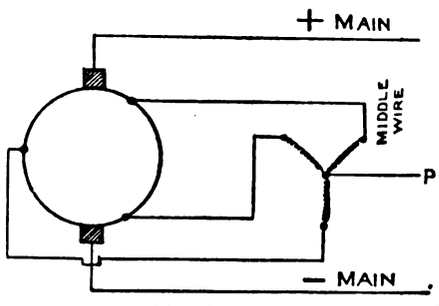

FIG. 1.

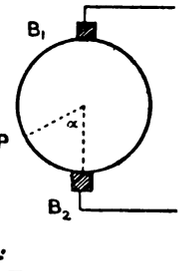

FIG. 2.

It is easily shown that at no load the voltage from either brush to the star point is half the voltage between the brushes. As is shown later the static balancer compares favourably with the rotary balancer both as regards capital and running cost but in operation it has one serious defect. With a rotary balancer the field windings can be compounded so that an exact balance is maintained right up to full load or if necessary the machine can be over-compounded so as to make up for the drop in the middle wire. With a static balancer neither automatic nor hand regulation can be provided; and, as the formula obtained below shows there is always a drop in voltage from the heavily-loaded side to the middle wire.

Let R be the resistance of the armature shown in Fig. 2.

Let B_2 be the heavily loaded brush of the machine.

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Consider an out of balance current being led into the armature at a point P which makes an angle α with brush B_2.

To calculate the voltage drop we require the average resistance from point P to brush B_2 as the armature rotates.

The resistance at a given instant works out to

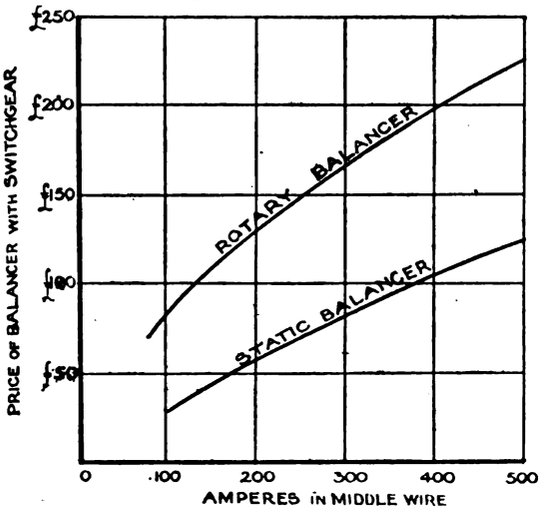

FIG. 3.

$$\frac{1}{\frac{\pi}{2R\alpha} + \frac{\pi}{2R(2\pi-\alpha)}}$$

The average resistance throughout one revolution

$$= \frac{1}{2\pi} \int_0^{2\pi} \frac{1}{\frac{\pi}{2R\alpha} + \frac{\pi}{2R(2\pi-\alpha)}} d\alpha$$

$$= \tfrac{2}{3}R$$

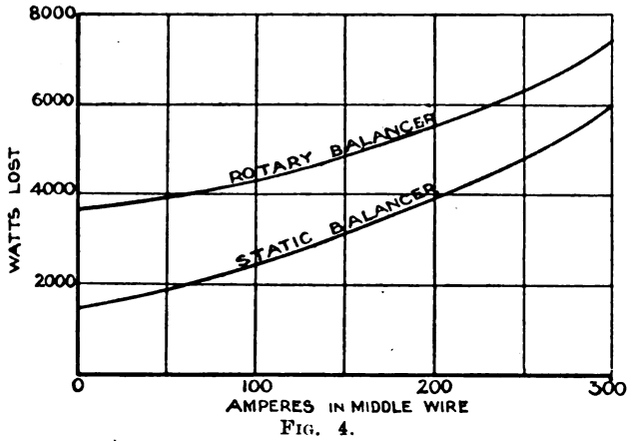

FIG. 4.

Note that this resistance is independent of the number of rings, but with more rings each path carries less current and the drop is therefore less.

Let there be N slip rings.

Let the resistance per arm of the balancer = R.

Let the out of balance current = C.

Current per ring is then $\frac{C}{N}$

The drop from the middle point to the loaded brush

$$= \frac{C}{N}(r + \tfrac{2}{3}R) \text{ volts.}$$

With regard to the comparative costs of the two types much depends naturally on the size and arrangement of the station. The accompanying curves give approximate costs for each type for sizes dealing with out of balance currents from 100 to 500 amperes. Switchgear has been allowed for in each case and in the case of the static balancers allowance has been made for fitting slip rings to the dynamo. The relative efficiencies are best compared by considering the losses in each type of balancer at various out of balance loads, The accompanying curves Fig. 4, show approximately the watts lost on a set of each type at various loads, the balancer being built to deal with an out of balance current of about 300 amperes on a 500 volt system.—H. W. B.

USE OF WATERFALLS IN SWEDEN.

H.M. Consul at Stockholm (Mr. H. M. Villiers, M.V.O.) has forwarded copies of two official reports, one in Swedish and one in German, on the exploitation of the Swedish waterfalls, from which the following particulars are taken :—

The total water power in Sweden is estimated at approximately 10,000,000 h.p., available during from six to nine months of the year, and 2,500,000 h.p. available during the time of low water. Of this amount 75% is in North Sweden, 15% in the province of Svealand, and 10% in Göteland. In the near future 600,000 h.p. will be in use, including 340,000 h.p. for the generation of electrical energy.

At the present time the State possesses, or is part proprietor of waterfalls of about 880,000 h.p., of which 670,000 h.p. could be used without previous regulation of the respective waterfalls. Only 63,000 h.p. is now in use by the State, including some 40,000 h.p. at the power station at the Trollhättan falls. Work is now in progress at Trollhättan by which a further 40,000 h.p. may be used there. At the great Porjus fall on the Lulea river, in Lapland, a power station is to be erected with a capacity of 50,000 h.p. In addition, the Swedish Government proposes to set up works at Alfkarleby, in Upsala län, Uppland, and at other places.

Preparations are in hand with a view to utilising the waters of Lake Waner and Lake Siljan. The Government is also turning its attention to the use of the water power in the centre and south of Sweden for working electric railways, and has to this end purchased waterfalls at a cost of 5,000,000 kronen (about £280,000). If the electrification of the line on the northern Swedish boundary proves satisfactory, electric traction will be extended further, and eventually to the whole of the State railways.

For the purpose of the better exploitation of the waterfalls, important extensions have been made in recent years in the means of communication in Sweden. The falls in the upper Lulea river are to be rendered accessible by the construction of a railway from Gellivare to Porjus. The Trollhättan canal also is being made capable of taking vessels drawing 4-5 metres (13-16½ ft.) at a cost of 23,000,000 kronen (about £1,280,000).

The present law as to the right of disposal of waterfalls is stated to be out of date and unsatisfactory, and the Waterfalls Commission (Vattenrättskommitten, Kungliga Vattenfallsstyrelsen, Arsenalsgatan 2, Stockholm) is preparing a draft for a more suitable law.

The reports mentioned above may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

FINANCIAL NOTES.

KAMINISTIQUIA POWER.—The directors of the Kaministiquia Power Company have declared a dividend of ¾%, or at the rate of 3% per annum, payable 15th proximo.

* * *

WHIPPLE & COMPANY, LTD.—£2,500, in £1 shares. Business: That of a manufacturing electrician, electrical engineer and contractor carried on by C. R. Whipple at Cook-street and Cable-street, Liverpool, as Whipple & Company. Private company. Office, 9, Cook-street, Liverpool.

* * *

THE LIMA ELECTRIC LIGHT, POWER, AND TRAMWAYS COMPANY, LTD.—This company are about to offer, through Messrs. J. H. Schröder, £1,200,000 of 5½% Debentures at 97.

* * *

CLYDE VALLEY ELECTRICAL POWER.—The accounts of the Clyde Valley Electrical Power Company for the half-year ended June 30 show a profit after providing for interest charges, of £10,519, reducing the debit to net revenue brought forward to £2,447.

* * *

PACHUCA LIGHT AND POWER COMPANY.—Messrs. Dunn, Fischer and Company announce that the issue of the Pachuca Light and Power Company has been oversubscribed. Country applications to hand or in course of post will receive consideration.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

BARNTON.—The Electric Lighting Committee of Edinburgh Town Council have had before them the proposal to extend their city's lighting mains to the Barnton district. The Committee have been advised that they have no power to extend the mains to Barnton, and the scheme has been shelved for the present.

BATH.—The application to the Board of Trade, made by the Corporation for the extension of their area to a radius of three miles from the Guildhall, has been granted, and the Corporation are now in the position to supply any demand within that area upon the terms of the Order.

BECKENHAM.—The engineer recommended that, subject to the provision of a minimum payment, the Council supply current and undertake the maintenance and trimming of consumers' arc lamps on the following terms:—Current to be supplied at 3d. or 5d. per unit, according to whether the lamps are inside or outside. Carbons at net cost. Labour, actual cost. Maintenance exclusive of broken globes, 20 per cent. on cost of lamps. The Committee recommended these terms for acceptance, and that consumers be permitted to purchase arc lamps on hire purchase terms spread over three or five years at 5 per cent. interest. The Committee recommended that where required prepayment meters be supplied. Price of current to include meter charge, 6d. per unit. The engineer reported the terms upon which he had provisionally arranged to supply electric current for the purpose of the Pageant at the Crystal Palace next year, and such terms were approved. These suggestions have been agreed to.

BRADFORD.—The past fiscal year for the City Electricity Department shows an increase in profits, which amount to £7,399, in spite of the large falling off of carrent sold for private lighting. There are more electric light consumers than ever, but the metallic filament lamps have resulted in a large economy. This has, however, been more than made good by the demand for power purposes (increase 1,164,497 units) and for heating (increase 498,705 units). The new method of charging is proving a success. Referring to the working of the two great turbo-generators recently fitted, the report states: "The alternating current generator of No. 1 set has been damaged on two occasions as the result of heavy short circuits. It was found necessary in each instance to return the machine to the makers for repairs. The contractors have thoroughly investigated the circumstances, and have taken steps which it is hoped will prevent any such occurrence happening again. Modifications were made in the second turbo-generator before it was put into commission, and this machine has since successfully withstood a heavy short-circuit. As far as can be ascertained no damage of any description has been done, the trouble having been confined to the alternator."

CARLISLE.—The Electricity Committee are about to lay a feeder cable in Lowther-street at a cost of £100. An important contract has been signed for the supply of current to Messrs. Cowan, Sheldon & Company's St. Nicholas Works.

CARNOUSTIE.—The Board of Trade have revoked the Carnoustie Electric Lighting Order, 1902, as confirmed by the Electric Lighting Orders Confirmation (No. 5) Act, 1902, as to the whole of the area of supply, the revocation taking effect as from October 13.

CHELTENHAM.—The Borough Electricity Department's accounts for the year ending March 31 show a total revenue of £22,230, of which £8,545 is for energy sold for general purposes, £3,750 to the Tramways, and £9,279 for public lighting. The expenses came to £8,856. The increase in units sold over the previous year was rather less than 16,000, about 1½ per cent. There was an apparent net balance of £958, but there is still an amount of £10,072 due on revenue deficit account.

HASLINGDEN.—The Town Council have requested that the Electrical Engineer of Bury should be permitted to act in an advisory capacity in connection with the local electricity undertaking. Permission has been readily granted.

HOLYHEAD.—The Town Council have approached the Admiral in command of the Port, the head of the Customs, and the City of Dublin Steam Packet Company, suggesting that the property under their respective jurisdictions should be supplied with electricity from the municipal works.

KEIGHLEY.—It has been decided to include a clause in the Bill to be presented in Parliament, by which the Borough will have power to supply electricity in bulk to any neighbouring local authority or company.

LEATHERHEAD.—A contract has been signed with Messrs. Siemens Brothers Dynamo Works, Ltd., for the supply and maintenance during 12 months of "Onewatt" high c.p. lamps for street lighting in the town and district.

LLANBRADACH.—The South Wales Electrical Power Distribution Company have received the County Council's sanction to the erection of poles and overhead wires for the electric lighting of this district.

NORTH BERWICK.—It is understood that the Town Council have come to an agreement with Messrs. Crompton & Company, Ltd., and that steps will soon be taken towards the installing of an electric lighting station.

REDDITCH.—Considerable criticism is being levelled against the Electricity undertaking, which, it is said, will show a deficit of about £3,000 this year.

SHEERNESS.—The Urban Council are considering a proposal from the Sheerness and District Electric Power and Traction Company, Ltd., to convert 75 gas lamps for electric lighting. It is proposed that these 75 lamps should be of 50 c.p. each, and the cost of lighting and maintenance would be £95 5s. per annum, if burning from sunset to 1 p.m. One suggestion is that a special armoured cable should be laid down and all the lamps controlled from one switch pillar. The cost of this would be £287, and the Company would be prepared to accept payment at the rate of £25 per quarter.

THORNE.—The Rural Council has been approached by some private individuals who desire to form a company to provide electricity for the district. The Council do not propose to take any steps in the matter.

WEST HAM.—The past year's trading of the municipal undertaking shows a debit balance of £93, and that in spite of an increase in the sale of current of close upon four million units, and the increase of revenue from £72,114 to £79,454. The average price obtained, however, has fallen from 1·02d. to ·93d. per unit. The price of production has been reduced from ·996d. to ·930d. per unit. In his report the electrical engineer says:—"I regard the function of the sales department not so much to show a profit in itself, but to increase the sale of electricity and extend the same in every way possible, thus benefiting the whole undertaking. The object of the department is not to obtain work at greatly enhanced prices, but to ensure that consumers who place orders with the Corporation are supplied with a sound, reliable, and efficient installation at a fair and reasonable price consistent with good work."

OVERSEAS.

BUENOS AYRES.—H.M. Consul has forwarded home particulars connected with the extension of the Military Port (Puerto Militar), which is situated near Bahia Blanca. The scheme provides for the execution of the following works:—(1) Dredging the entrance canal and the tidal basin; (2) building a wharf in the basin and two piers at its entrance; (3) constructing a dry dock measuring 402·60 metres of actual available length, divided into two sections of 183 metres each; (4) setting up a pumping house for emptying the dry dock, and machinery for generating electrical energy; (5) building sheds, workshops, offices and dwelling houses for the staff; (6) sanitary and other necessary works. At present tenders are only invited for one section of the dry dock, and for the wharf in the tidal basin with the two corresponding piers. Tenders will be received by the "Dirección General de Obras Hidráulicas, Ministerio de Obras Públicas," Buenos Ayres, up to December 15. The works may be completed within three or four years, and are to be fully equipped; among other things a 150-ton crane is to be provided. Plans and particulars may be obtained, on payment of 200 pesos (£17 10s.), from the Comisión de Ampliación del Puerto Militar, Buenos Ayres.

PORT-AU-PRINCE.—The Haytian Legislature have extended for a period of two years from September 3 the time allowed MM. Augustin jeune and Joseph Dégraff for the installation of an electric light and power system for the towns of Les Cayes and Jérémie.

REICHENBERG, AUSTRIA.—The Town Council are seeking powers to borrow £725,000, part of which will be expended on an electric light and power station, and on the construction of a tramway.

TRACTION.

HOME.

BELFAST.—The Council have at last decided to promote a Bill next Session for the extension of the city tramways to M'Art's Fort. The estimated cost is £62,139, made up as follows:—Double track, £41,639; equipment and machinery, £20,000; land, £500. Powers for the other tramway extensions will be sought for in an Omnibus Bill.

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EDINBURGH.—The Tramway Committee have had before them various points in respect to which they intend meeting representatives of the Tramway Company in conference. The matters to be discussed include the improvement of the front guards on the cars and of the indicating lights at night. An extension of transfer tickets will also be suggested, including Lauriston to Craiglockhart and Marchmont-road to Morningside.

HEYWOOD.—A suggestion is made that a tramway should be laid along the handsome new road just constructed between here and Middleton.

LEEDS.—The City Tramways Committee have issued an illustrated guide to the whole tramway system, which contains a large map, time-table and list of fares.

TORQUAY.—Efforts are being made to arrive at some understanding between the Town Council and the Tramway Council, probably on the lines of a compromise. If the steps taken prove successful, among other benefits will be the taking in hand without delay of the extension to Paignton, with a view to its being open by Easter.

OVERSEAS.

PORT-AU-PRINCE.—The Haytian Legislature have approved plans lodged by the Concessionaire for a railway from Port-au-Prince to Pétion-Ville. The trains are to be run by electric traction, and fitted with automatic brakes. Interest is guaranteed by the Government on a sum of 214,000 dollars (about £44,600).

SALTA, ARGENTINE.—The Legislature of the Province of Salta has granted a concession to Mr. E. Barvil for electric tramways in the city of Salta.

SANTA FÉ, ARGENTINE.—The Mayor has signed the contract with Messrs. Winby and Company for the electrification of the tramways and the construction of a power house.

TORONTO.—The Imperial Trade Correspondent (Mr. F. W. Field) has forwarded a copy of a report, presented to the Toronto City Council on September 1, on the existing traffic conditions in that city and on the present tramway system, and containing recommendations for the construction of a system of underground tramways, to be worked in conjunction with the present surface system. In this connection, Mr. Field says that the city authorities propose to construct street car lines in districts which at present the Toronto Street Railway Company (which has the exclusive privilege to work street railways within the City limits) refuses to serve. The length of the proposed lines is 9·7 miles, of which 1¼ miles would be single track, and the cost of the work is estimated at 750,000 dollars (about £154,000).

VICTORIA, BRAZIL.—A decree has been issued approving plans and specifications for the electrification of the Victoria-Diamantina Railway from Victoria to Itabira de Matto Dentro. The cost of the work is estimated at 52,687,000 milreis (about 3,950,000), and is to be defrayed, in accordance with the terms of a previous decree, from the receipts from the carriage of minerals.

COMPANIES' MEETINGS AND REPORTS.

ELECTROLYTIC ALKALI.

The annual report of the Electrolytic Alkali Company shows that, after allowing for depreciations, Debenture interest, renewals, etc., there is a net profit of £10,901. To this is added £15,177 from last year. Three years' Preference dividends are due, and the directors now propose paying one and a-half year's dividend—namely, 10½%. This leaves £15,582 to carry to next account. Over £16,000 has been spent in additional plant to introduce new sources of revenue. The report states that the benefit therefrom will be gradual, but, it is believed, permanent.

STIRLING AND BRIDGE OF ALLAN TRAMWAYS.

The report for the year to August 31 last states that the total earnings for the year have amounted to £4,944, being a decrease of £305 as compared with those of the previous year. On the St. Ninians section there has been a decrease of £169. The expenditure under revenue has been £4,543, being an increase of £71 as compared with last year, and a decrease of £258 as compared with the year previous. The balance at credit of revenue is £400, being a decrease of £377 as compared with the previous year, the falling off being largely owing to decrease in traffic drawings. Of the balance at credit, the directors recommend that £320 be applied to payment of a dividend of 4% (less income-tax) on the Preferred and Second Preferred shares, leaving £80 to be carried to renewal account. The directors regret that the past year has been comparatively so unprofitable, thus precluding the payment of any dividend on the Ordinary shares.

ROSARIO ELECTRIC.

The report for the year ended June 30, 1910, states that the balance at the credit of profit and loss account, after making provision for depreciation of buildings, plant, etc., and for expenses of issuing new capital, is £44,299, to which must be added the amount brought forward from the last account of £9,282, making a total of £53,582. The directors propose a dividend of 5s. per share on 22,759 Ordinary shares (making a total dividend of 8% for the year); at the rate of 8% on the amounts paid up on 20,000 Ordinary shares; to appropriate £600 as additional remuneration to the directors, and to add to reserve £25,000, leaving a balance to be carried to next account of £9,306. At an extraordinary general meeting on February 28, 1910, the company approved of an agreement for the granting of an option to the Société Financière de Transports et d'Entreprises Industrielles (of Brussels) to purchase the undertaking of the company, which agreement contemplated that the société might acquire the undertaking either by a transfer of the concession and property or by the acquisition of the share capital of the company. The société provided the guarantees required by that agreement, and declared their intention of exercising their option. Subsequently the Société Financière formed a company, the "Société d'Electricité de Rosario," to take over the undertaking. In pursuance of the agreement the Société Financière and the Société d'Electricité de Rosario have purchased upon the terms named in the agreement more than 97% of the share capital of the company, and have announced their readiness up till December 31 of this year to purchase the remaining shares upon similar terms. A supplemental agreement ad referendum, dated October 4, 1910, has been made between this company and the Société Financière, altering the limit of time within which the Société Financière are to take transfer of the company's undertaking from December 31, 1910, to June 30, 1911, and releasing the guarantees as being no longer required. This agreement will be produced at the general meeting, and submitted for ratification. In order to facilitate the conduct of the business of the company pending the complete transfer, it is proposed to appoint Mr. D. Heineman and Mr. F. Comes, representatives of the Société Financière, to be additional directors of the company.

ELECTRICITY IN RAILWAY SHOPS.

Machine Tools, Group-Drive, and the Questions of Current.

The remarkable progress which has been made in recent years in the application of electrical energy to the operation of railway shops forms the subject of a paper presented by Mr. J. C. McElree, chairman of the American Association of Electrical Engineers at the recent meeting of that body in Chicago. It embodies the conclusions arrived at by a special committee on shop practice, and has an important bearing, as will be seen from the summary transmitted by the New York correspondent of THE ELECTRICAL ENGINEER upon railway shops in all parts of the world.

Probably in no industry, says the report, has the use of electricity made more rapid strides than in the operation of railroad shops, beginning in the early nineties by the operation of each department with a single large motor, and extending through the multiple voltage system, which offered the first solution of the problem involving variable speed for individual machine tools, to the present time, when alternating current is the recognised best method of operating constant speed motors, and direct current with field control for tools requiring variable speed characteristics.

In some classes of machinery, not, however, found in railroad machine shops, the horse-power varies directly with the speed, and for operating such machines multiple voltage motors would be wholly applicable. In the case of lathes, boring mills, shapers, etc., requiring variable speed motors for their operation, the horse-power is practically constant throughout the speed range, inasmuch as the cutting speed remains the same; therefore a motor, where the horse-power varies directly as the speed, would be wholly inapplicable, and if large enough to furnish

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sufficient power at low speed the cost and efficiency, as we look at it to-day, would be prohibitive.

In addition to the variable speed motors now on the market, with field weakening control secured by insertion of resistance in field circuit, one manufacturer is building motors where the field strength is changed by sliding the armature in and out of the field flux by the use of a hand-wheel on the end of the motor shaft. When it is necessary, as is usually the case to place the motor at a distance from the operator, this operation is performed through a system of sprocket wheels and chains.

Reference is made in the report to one shop where alternating current is used throughout, including all individual machine tool drives and cranes, and it is observed that while such an arrangement provides many advantages in the way of flexibility, efficiency, and possibly decreased operating expense as applied to the generation of power, it is obviously necessary to use belts and cone pulleys at a great many of the machine tools in order to secure speed variation; and thus one of the main advantages made possible by the use of individual motor drive, namely, facility of speed control, has been eliminated. There is no doubt that alternating current should be used as extensively as possible, but not in such a manner as to be detrimental to maximum shop production.

The power plant equipment should in all cases have the first consideration, and in the building of a new shop vast benefits will be derived by first constructing and equipping the power plant in order that the power derived therefrom may be available to assist in the construction and equipment of the various departments. A model, up-to-date power plant built to operate on economic principles generally contains turbines as prime movers. In numerous cases, however, condensing water is not available, and reciprocating cross compound engine units are installed.

It is generally conceded that the prime generating units should be alternating current and that synchronous motor-generator sets of sufficient capacity be used to obtain direct current for overating individual motors on variable speed machine tools. The use of direct current is sometimes extended to cranes, transfer tables and turn-tables. Recent experience, however, in the case of alternating current for these purposes, has been wholly satisfactory, and a reduction in first cost, as well as operating expenses, can be made by using direct current for the operation of variable speed motors on machine tools only.

The use of alternating current as against direct current motors in cranes should receive the most serious consideration. It seems to be the universal practice with crane builders to increase the selling price of cranes about 15 per cent. for the substitution of alternating current motors for direct current motor equipment. If it is necessary to convert alternating to direct current for crane operation, however, this 15 per cent. excess in the first case is offset by the decrease in cost of motor generator sets. The load factor in motor generator sets would be much higher without the variable crane load. With alternating current motors speed for the various operations would be practically constant without respect to the load. This means that hoist and bridge motors must be about 50 per cent. larger than direct current motors in order to perform the same amount of work.

Due to the characteristics of series-wound direct current motors, speed under no-load conditions would be about double that at full-load, and the mean difference between the no-load and full-load speeds would be about the correct speed for which the alternating current motors should be geared. The speed under load could be reduced by the controller, with the horse-power falling off in direct ratio to the reduction in speed. On the whole, when the argument of increased first cost has been advanced, no other objection can be sustained against the use of alternating current motors in crane practice. It has been demonstrated in numerous instances that a fine regulation of speed control can be obtained for handling material in and out of machines, and this, together with low maintenance charges, should convince the engineer of the advisability of an alternating current crane motor installation. These remarks apply equally to transfer and turn-table equipments as for other installations where motors must have similar characteristics.

There seems to be an increasing sentiment on the part of machine tool builders to furnish all gear speed change machines, which can readily be standardized for either belt or constant speed motor drive. It is doubtful, however, whether this is a step in the direction of increased production, toward which every effort should be turned on account of the constant increase in cost of labour. There is no doubt but what the facility with which a speed change can be accomplished is the determining influence on the part of the machine tool operator to increase or decrease speed as conditions warrant, and in no manner can it be more readily effected than through the medium of a controller to vary the field strength of the motor.

On account of the cost incidental to individually equipping all machine tools with motors, many engineers group the smaller machines on sections of line shafting operated by motors of the correct capacity. The proper size of motor for any designated grouping of machine tools is a question that can only be decided by knowledge of the number of machines, and general shop operating conditions. As a general proposition the capacity of the motor for operating a group of machines should be about 50 per cent. of the combined capacity of the motors which would be applied to tools if individually driven.

In the case of a planing mill, group drive should not be considered except possibly for the very light auxiliary apparatus, such as knife grinders, pattern lathe, etc. Even the objection to individual motor application, of increased first cost, cannot be advanced, for elimination of shafting and belting, together with the low cost of high speed motors which can, as a rule, be direct-coupled to the machine, makes the original outlay about on a par with a group-drive installation, while the operation is incomparably better. The average load, as compared with the maximum requirements, represents a lower percentage than any other department of a railroad shop and the absence of line shaft, frictional losses, etc., means a net saving of at least 33 per cent.

Reference is also made to two motor applications, which should find considerable favour in railroad shop work. One of these demonstrated the practicability of using independent motor-driven blowers for blacksmith shop forges, and the other illustrated the operation of a chipping hammer by a motor through flexible shafting. Heretofore it has been quite customary to pipe compressed air to one or two forges in the blacksmith's shop for night, holiday and Sunday work. Compressed air is expensive, whereas an outfit as mentioned above operates for a cost of about a halfpenny an hour. Compressed air was substituted to avoid the necessity of running large blowers; now we have a far better substitute than compressed air and one that can be used universally throughout the shop with most satisfactory results, the first cost being slightly higher than a large blower and necessary piping. The small individual blower equipments can be purchased at a comparatively low cost by reason of the development of high speed motors for their operation.

DIARY.

FRIDAY, OCTOBER 28.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Section).—At the Physical Laboratory, Manchester University, at 7.30 p.m., Chairman's Inaugural Address by Mr. J. S. Peck, to be followed by Smoking Concert.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, South Kensington, at 5 p.m., Professor Ernest Wilson and Mr. W. H. Wilson, "Exhibition of a New Method for Producing High-Tension Discharges." Mr. F. Rogers, "The Behaviour of Steel under combined Static Stress and Shock," with exhibition of apparatus.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—At 7.30, at the Philosophical Society, Westgate-road, Newcastle-on-Tyne, Inaugural Address by the President, Col. R. Saxon White. Presentation of Institution Scholarships.

SATURDAY, OCTOBER 29.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Fleet-street, Social, "Ladies' Night."

TUESDAY, NOVEMBER 1.

INSTITUTION OF CIVIL ENGINEERS.—At 8 p.m., at Great George-street, Westminster, Address by the President, Mr. Alexander Siemens, and presentation of Medals and Prizes.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

COUNTY OF LONDON.

The LONDON COUNTY COUNCIL invites Tenders for the supply of ASH DUST REMOVING PLANT, by means of suction fans, for the electricity generating station, East Greenwich, S.E.

Persons desiring to submit Tenders may inspect the drawings and obtain the specifications, bills of quantities, form of Tender, etc., at the Department of the Clerk of the Council, County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of £2. This amount will only be returned if a *bona-fide* Tender is submitted. Full particulars of the work and conditions of contract may be obtained at the County Hall before the payment of this fee.

The Contractor will be bound to pay to all workmen employed by him in and about the execution of the contract, or any part thereof, wages at rates not less, and to observe hours of labour not greater, than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule. Full particulars of the Council's Standing Orders on these matters are given in the London County Council Gazette.

Tenders must be upon the official forms, and the instructions therein must be strictly complied with.

No Tender received after 11 a.m. on Tuesday, December 6, 1910, will be considered.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who has withdrawn a Tender after the same has been opened, unless the reasons for withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall, Spring-gardens, S.W.,
October 25, 1910.

BUCKINGHAM UNION.

The Guardians of the Buckingham Union invite Tenders for :—

A. A complete installation for the generation and storage of electric current.
B. A complete system of wiring suitable for a voltage of 100 with 70 lights or thereabouts.
C. A complete system of wiring suitable for a voltage of 220 with 70 lights or thereabouts.

Further particulars can be had on application to the Clerk, 26, West-street, Buckingham.

Tenders to be delivered at the Clerk's Office not later than Friday, November 4th, 1910.

The Guardians do not bind themselves to accept the lowest or any tender.

By Order,
THOMAS R. HEARN,
Clerk.

Buckingham,
October 24, 1910.

APPOINTMENT.

CORPORATION OF BRISTOL.

ELECTRICITY DEPARTMENT.

The ELECTRICAL COMMITTEE are prepared to receive applications for the following posts :—

1. AN ENGINEERING CANVASSER with a good experience in obtaining Electric Power Business; the application, relative economy, and method of applying the different sources of energy in mechanical driving, and preferably a general experience in Publicity and Sales Business in connection with an Electricity Department. Salary, £156 per annum.
2. A SHOW ROOMS AND SALES DEPARTMENT ATTENDANT, experienced in the routine work of an Electrical Showrooms and Sales Department, and capable of advising consumers on minor technical matters. Salary, £91 per annum.

Applications, with copies only, of Testimonials and endorsed "Applications," must reach the undersigned not later than Friday, November 4th, 1910.

Canvassing will be deemed a disqualification.

H. FARADAY PROCTOR,
M.Inst.C.E., M.Inst.E.E.
Engineer and Manager.

Electricity Department, Temple Back,
Bristol.

OFFICIAL NOTICE.

BELFAST CORPORATION.

ELECTRICAL EXHIBITION

OF

Appliances for Heating, Cooking, Lighting and Power

WILL BE HELD IN THE

ULSTER HALL,

FROM THE

9th January till the 21st January, 1911.

Forms of Application for Space, and Regulations to be observed by Exhibitors, may be obtained from the City Electrical Engineer, at the Electricity Works, East Bridge Street, on or after the 1st November.

(Signed) R. MEYER,
Town Clerk.

CONTRACTS OPEN.

HOME.

BRADFORD.—Corporation Tramways.—Miscellaneous stores. (Specification, £1 1s.), from the Manager. November 12.

BUCKINGHAM.—The Guardians of the Union invite tenders for (a) complete installation for the generating and storage of electric current; (b) complete system of wiring suitable for a voltage of 100 with 70 lights; (c) complete system of wiring suitable for a voltage of 220 with 70 lights. Particulars from the Clerk to the Guardians, 26, West-street, Buckingham. November 4.

DUBLIN.—The United Tramways Company, Ltd., invite tenders for the supply of general stores, including car fittings, iron, steel, castings, oils, paints, glass, brushes, ironmongery, harness materials, electric supplies, timber, etc., for the year ending December 31, 1911. Forms (2s.) from the Secretary, 9, Upper Sackville-street, Dublin. Nov. 7.

LONDON.—The London County Council invite tenders for the supply of ash dust removing plant, by means of suction fans, for the electricity generating station, East Greenwich. Particulars (40s.) from the Clerk to the Council, Spring-gardens, S.W. December 6.

MORECAMBE.—The Corporation invite tenders for the supply of 2,400 tons of slack to be delivered over a period from December, 1910, to May, 1912. Particulars from the Town Clerk. November 1.

PETERBOROUGH.—The Corporation invite tenders for the supply of 4,716 yards of distributor cable. Particulars from the City Electrical Engineer. November 3.

OSRAM·LAMPS

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
HULL.

OVERSEAS.

BENI-SOUEF, EGYPT.—The Minister of the Interior invites tenders for the supply and installation of machinery, etc., required for the establishment of water supply and electric light systems in the town of Béni-Souef. Tenders, on stamped paper (obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W.), and enclosed in two envelopes, the inner marked "Installation d'eau et d'éclairage, électrique à Béni-Souef—offre pour la partie électrique et mécanique," and the outer addressed to "M. le Directeur de la Section des Municipalités et Commissions Locales, Ministere de l'Intérieur," Cairo, will be received up to noon on October 31. The specifications, drawings, etc., may be obtained at the same address on payment of 200 piastres (£2 1s.). A deposit equal to 2 % of the value of the offer is required with each tender. It is to be noted that the Egyptian Ministry of the Interior requires contractors to have a responsible agent in Egypt.

CONSTANTINOPLE.—Construction of wireless station near Smyrna with radius to Derneh in the Banghazi (Africa) district. Particulars from the Post and Telegraph Department. November 1.

FOCSHANI, ROUMANIA.—The Commune invite tenders for the electric lighting of the town. Tenders, which will be opened on November 2, should be accompanied by a preliminary deposit of 35,300 lei (about £1,400), and addressed to "La Mairie de la Ville de Focshani," Focshani.

SYDNEY.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to November 16, for the supply of telephone, telegraph, and electric light material (Schedules Nos. 27–43). A deposit will be required with each tender. Local representation is necessary. For copies of the specification, and forms of tender in regard to each of the above contracts application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications, together with drawings, may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

TENDERS ACCEPTED.

HOME.

LONDON.—The London County Council have accepted the tender of the Phœnix Aktien-Gesellschaft für Bergbau und Hüttenbetrieb, Abteilung Ruhrort, Duisburg-Ruhrort, Germany, for the supply of 4,800 tramcar driving wheel tyres at £4,080, and John Batt & Company (London), Ltd., Old Broad-street, E.C., who will sublet to the Vereinigte Stahlwerke van der Zypen und Wisten, Cologne-Deutz, Germany, for the supply of 1,600 tramcar pony wheel tyres at £1,013.

LONDON.—The General Post Office have given a contract to Messrs. Siemens Bros. Dynamo Works Ltd., for the supply of Tantalum and Onewatt lamps.

NEWPORT.—The Corporation have recently accepted tenders for the following apparatus:—Carbon lamps: Edison & Swan and the General Electric Company, Ltd. Radiator lamps: Edison & Swan. Various electrical meters: Electrical Company, Ltd., Bat Meter Company, British Westinghouse Company, Electrical Apparatus Company, Ltd. Rubber cables: General Electric Company, Ltd. Single paper cables: Callender's Cable and Construction Company, Ltd. Sale of superseded plant: C. D. Phillips, Newport. Steel girder work: T. H. Howell, Ltd., Newport; Cast iron pipes: Jordans, Ltd., and Thos. Spittle, Ltd., Newport. Cast iron stanchions: W. A. Baker & Company, Ltd., Newport.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ATHERSTONE: Mr. H. J. Coleby, Engineer to the Rural District Council. Isolation hospital.

BACUP AND RAWTENSTALL: Mr. H. Littler, 16, Ribblesdale-place, Preston. Secondary and technical school at Waterfoot.

GATESHEAD: Newcombe and Newcombe, 89, Pilgrim-street Newcastle-on-Tyne. Two pavilions of three floors, with administrative block for aged poor.

MANCHESTER: H.M. Office of Works, Storey's Gate, Westminster. Labour Exchange.

NOTES.

Zed Fuses.

The electrical installations of many of the largest buildings now in course of erection are being protected by the "Zed" type of fuse recently placed on the market by Messrs. Siemens Brothers Dynamo Works, Ltd. These well-known cartridge fuses are not only meeting with the warm approval of consulting engineers, supply companies and insurance authorities, but are also welcomed by contractors and wiremen as a great advance in this class of apparatus. Amongst the buildings which are being equipped with "Zed" fuses may be mentioned the Royal Liver Buildings, Liverpool, the new Y.M.C.A. Buildings, Manchester, the Newport Technical Institute, the Palladium Theatre, London, and numerous collieries, schools, churches, cinematograph shows and private houses.

At Messrs. Siemens' Stafford Works a new shop is now being equipped exclusively for the production of these fuse fittings, cartridges, etc., and two new sizes, to be called "ZIV" and "ZV" respectively, with cartridges for a normal capacity of up to 100 and 200 amperes, will be placed on the market in the course of the next few weeks.

Owing to the rapid growth of the demand for these fuses, Messrs. Siemens have been obliged to increase very largely their stocks of cartridges and fuse fittings in order to meet customers' requirements without delay. Those who have not yet investigated the advantages of these simple, reliable and convenient fuses should write for particulars to the firm's showrooms and stores at 39, Upper Thames-street, London, E.C.

Osram Lamps for Johannesburg Street Lighting.

The British General Electric Company, Johannesburg, have recently secured a contract for 4,000 Osram lamps, which are to be used for the entire equipment of the incandescent street lighting scheme adopted by the Johannesburg Municipality. This selection was, we understand, made after very severe and lengthy tests of all the best known makes of lamps—the Osram having been adopted exclusively for the purpose named.

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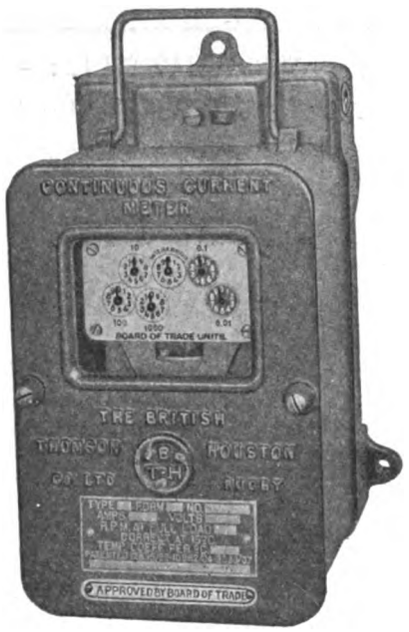
B.T.H. Continuous Current Ampere Hour Meter. House Service.

Ampere-hour meters, because of their simplicity, reliability and small losses are now in general use for measuring the units consumed on continuous current circuits. The British Thomson-Houston Company have developed and placed on the market an improved type of mercury ampere-hour meter which possesses material advantages over any other ampere-hour meter used, as evidenced by the fact that the characteristic curve closely approximates a straight line from full load down to one-twentieth of full load, the meter starting to register easily with a load equal to ½% of its rated capacity. The design of this meter has been so carefully worked out that it has been found unnecessary to employ compounding, and the meter has not the disadvantages inherent in all other meters of this type, in which it has been necessary to adopt some form or other of compounding. This meter, therefore, has the advantages of a very small voltage drop and watt loss, has no hysteresis



error and is unaffected by short circuit currents. The meter is calibrated by altering the electrical circuit and not by distorting the magnetic field, so that a very permanent calibration is obtained, which is not the case when the latter method is adopted. All parts of the meter are made of metal which will not warp with changes of temperature or excessive heat, and as they are made standard and interchangeable, any part can be readily replaced from stock. The British Thomson-Houston mercury ampere-hour meter, which is illustrated herewith, has been approved by the Board of Trade, and is calibrated to read in British Thomson-Houston units at any specified pressure up to and including 600 volts.

"Excello" Arc Lamps.

The Union Electric Company, Ltd., have just brought out a new list, No. 5015, of Excello arc lamps, which supersedes their former issue. It has been brought quite up to date in respect of the reading matter and data. On page 9 are some useful data relating to the candle powers, pages 10 and 11 are devoted to describing the deposit free covers, a most notable improvement, as this devise keeps the globes always clean. Pages 16 and 17 are instructive, as they show the construction and illumination curves; while on pages 20 and 21 are illustrated several new designs of covers for fitting to the lamps, and on pages 13 and 14 a full description of the duplex long burning lamps is given. The whole subject is very exhaustively treated, so it will be understood that this price list is well worth having.

APPOINTMENTS VACANT.—The Electricity Department of the Corporation of Bristol are advertising for an engineering canvasser, at a salary of £150 a year, and a Show Room and Sales Department Attendant, at a salary of £91 a year. As will be seen on referring to our Contractors' Section, applications must be sent in by November 4.

PATENTS.

Electrical Perforating Apparatus.

3825.—1910. B. H. WALLIN, Göteborg. In this apparatus for producing stencils by perforating designs on paper, an electro-magnet is mounted on a flat base plate and provided with a bent armature placed close above the pole of the electro-magnet. One limb of the armature is vertical and fastened in an elastic manner to the base plate. The other limb is horizontal and free. A needle-holder at the fixed end of the armature is directed at right angles against the base plate.

Circuit Closing and Opening Devices.

4883.—1910. O. OEHRING, Berlin. The contact spring which causes the circuit of the coin freed apparatus to be closed in consequence of the wedge action of the coin inserted forms one side of the passage for the coin. The other side of the passage is formed by a double-armed lever. The upper arm of the lever rests against a cam. The cam moves the arm and sends the coin down the shoot.

Dynamo Electric Machines.

4907.—1910. J. L. FARNY, Zurich. In this machine which has no commutator and is provided with field magnet poles of unlike dimensions so that they produce unlike positive and negative pressure valves, the core of the armature presents a useful current winding and one or two more supplementary windings. The armature is so wound that the sum of all the magneto motive forces due to the individual windings is approximately zero, so that the self-induction of the armature is reduced.

Electric Motor Starting and Speed Controlling Apparatus.

21357.—1909. A. C. HEAP, Salford. This improved switching device for alternating current circuits comprises switch gear and a transformer, the secondary voltage of which can be varied from a minimum to a maximum value by alteration of the inductive relationship between the primary and the secondary in a continuous manner. The connections are so arranged that the primary may first be connected to the main supply and the secondary to the circuit terminals. After the secondary voltage reaches its maximum the circuit terminals may be connected directly to the mains and the transformer windings be cut out of circuit.

Tele-Selectors.

21752.—1909. E. BLOS, Schöneberg. The sender is provided with rows of contacts corresponding to the variations in current impulses chosen for the various characters of the numbered plurality of members to be selected. The number of rows corresponds to the base of the numeral system chosen for the numbered plurality. This arrangement lessens the number of contacts necessary and consequently reduces the size of the sending board.

Electrically Driven Machine Tools.

21803.—1909. W BEARDMORE & COMPANY, AND J. A. SYKES, Glasgow. The object is to provide simple and effective means for automatically reversing and controlling the action of reversal of electrically driven machine tools. The apparatus comprises a tumbler device the falling of which is controlled by a dashpot contrivance. An electric controller switch connected to the tumbler operates the circuits for reversal and control of the motor by which the tool is driven.

Time Lag Device.

24115.—1909. G. ELLISON, Birmingham. The object is to provide a simple and cheap time lag for electric circuit breakers. The invention comprises the employment in conjunction with a plunger or similar element operated by a solenoid, of a dashpot or fluid cushion in which the resistance to flow of the liquid from one side of the piston varies with the position of the piston.

Electric Motor Control.

25205.—1909. H. C. WELCH, AND H. C. PARKMAN, Boston, Mass. The invention has particular reference to electric motors of the variable speed type such as are used for the operation of elevators, machine tools and vehicles. Combined with the motor which has a number of poles and a number of windings on each pole, one winding of each pole being of a relatively high ohmic resistance and a large number of turns, of a switch and connection whereby in successive position the coils are successively removed from circuit.

Metallic Conduits for Electric Conductors.

25822.—1909. B. L. MYER, Liverpool. This improved method of ensuring electric continuity in metallic conduits consists in forming the sockets of the various fittings with nibs. Between the nibs is a slit portion. Saddle pieces with projecting ends engage with the nibs. The engaging parts are tapered so that as the saddle is driven home the conduit is tightly gripped in the slit socket.

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Producing or Transmitting Electric Current Waves.

9539.—1910. J. RABINSOHN, Canonbury, N. This wireless telegraphy or telephony apparatus comprises a core or armature coupled to the high frequency oscillation circuit and directly connected to a vibrating membrane or diaphragm or other source of vibration by a transmitting device.

Telephone Disinfection.

15318.—1910. A. HOFERMANN, Elberfeld. A disc is saturated with a liquid which permanently retains its disinfectant property. The shape of the disc is such that it allows sound waves to pass through unhindered. It may be placed on any mouthpiece or receiver.

Holders for Electric Incandescent Lamps.

15933.—1910. R. F. RUSSELL & E. T. HUTSON, London, E.C. Combined with the holder is a contact device comprising a member carrying contact strips. The leading in wires of the holder are connected to the contact strips. Pointed screws form electrical connection between the main and contact strips. Means are provided for holding the contact device to the lampholder.

Luminous Signal Indicating Apparatus.

17733.—1910. T. C. L. VIETTE, Paris. This indicating apparatus for producing simultaneously the lighting of a lamp and the appearance of a signal supplementing the luminous signal, comprises an electromagnet provided with an armature which, when the call button is pressed, produces the release and appearance of a second signal, which causes the lighting circuit of the lamp to be closed.

Rotary Motors.

18459.—1910. F. HODGKINSON, Edgewood Park, U.S.A. The object is to produce means for supporting the stationary casing of rotary motors which will permit the casing to expand and contract under the variations of temperature. The stationary casing is mounted on pedestals provided with means for accommodating the longitudinal expansion and with separate means for accommodating the lateral expansion of the stationary part.

Charging and Discharging Accumulators.

18633.—1909. A. M. TAYLOR, King's Heath. Bucking boosters are employed in conjunction with arrangements for connecting two or more booster armature windings. The arrangement reduces the output of the main boosters and increases the number of cells in the battery. The bucking boosters and main boosters are protected against undue rushes of current.

Voltage Regulation.

20869.—1909. W. J. WALTERS, Rugby. In this automatic voltage regulator the electric magnetic influence acts upon a disc to effect its movement when the voltage varies from the normal. This movement operates a medium for adjusting a variable resistance. The electro magnet windings receive energy from the points at which the voltage is required to be maintained at normal value.

Arc Lamps.

21008.—1909. L. L. D. CIBIE, Paris. The negative carbon is held and guided in a socket which has a spherical bearing resting freely in a cavity of the same form in the baseplate of the lamp. The lower end of the carbon rests against a stop at the bottom of the socket.

Distribution of Electric Energy.

21219.—1909. W. F. ANDERSON, S. A. RUSSELL, AND W. E. GRAY, Silvertown, E. This electric distribution system comprises a dynamo, two batteries of accumulators, charge and discharge, and switching mechanism. When the dynamo is running below a certain speed current can be supplied to an external circuit by both batteries. When the dynamo attains a certain speed, part of the current generated by the dynamo can be supplied to an external circuit and part to the charge battery, there being a demagnetising winding on the field magnet of the dynamo to prevent the battery from being charged at an excessive rate.

Selective Switch Systems.

21303.—1909. GENERAL ELECTRIC COMPANY, Schenectady, U.S.A. In an electric traction system in which sections of the line are supplied with current at different potentials means are carried by the car for reducing the potential when the car is on a section supplied with current at high potential. Provision is made for automatically connecting the car circuits either directly to the source when the car is on a low potential section or to the potential reducing means when the car is on a section supplied with current at high potential.

Supply Conductors.

22287.—1909. J. S. HIGHFIELD, London. This is a flat twin conductor for electrical installations and comprises an insulating strip containing two or more conductors formed by passing the conductors through a die adapted to form a flat strip and continuously spraying the insulating material about them. The strip is then covered with braid or tape and treated with a composition to impart a smooth surface.

Electric Telegraph Insulators.

22878.—1909. J. BALL, AND C. F. READMAN, Hanley. The insulator comprises a support which carries a screw-threaded metal head coated with insulating enamel. Two cups nested one within the other and coated with insulating enamel are firmly secured between a flange on the support and the screw-threaded head. When assembled together the parts form a high-grade insulation which is practically unbreakable.

Electric Switches.

25278.—1909. H. R. SCHULTZ, AND F. B. HOLT, Manchester. The ammeter and overload tripping coil connected in the high tension circuit are supported on one of the high tension conductors within the switch casing. The switch is provided with automatic opening mechanism operated by actuating members which are entirely insulated from the portions of the switch subjected to a high potential. The opening mechanism is located in a separate but readily accessible casing.

Coupling Device for Electric Cables.

25449.—1909. HENLEY'S TELEGRAPH WORKS COMPANY, LTD., AND S. H. PENNING, London, E.C. In order to enable a branch conductor to be connected to any selected core of a multi-core electric cable, a ring is provided which is formed of conductive material and divided diametrically and adapted to be halved together to surround the cable. A set screw is inserted into one of a series of holes in the ring. The screw holds the ring in place and at the same time establishes connection between the selected core of the cable and the ring. A second set screw adapted to be inserted through another hole of the same series secures to the ring a socket terminal for the branch conductor.

Inter-Communication Telephone Systems.

28951.—1909. G. BURNEY, AND STERLING TELEPHONE & ELECTRIC COMPANY, LTD., London, E.C. In this improved system lamps are used at the stations as visible indicating signals. A bell is put in the circuits by means of a relay which has a number of windings corresponding with the number of lamps.

Electric Generating Machines.

30333.—1909. E. M. FITZ, Columbus, U.S.A. This generating machine is designed to be carried and operated by the axle of a car or locomotive. An armature is clamped to the axle and carried on it by elastic supports. The field magnets are contained in a casing having bearings to which the armature bearings are journalled. Safety mechanism is provided for holding the casing against revolution and for releasing the casing when subjected to impact that would otherwise break it.

Electric Brushes.

1145.—1910. W. A. STEVENS, AND A. T. LAMBERT, Maidstone. The object is to provide simple means for holding the brush temporarily away from the commutator. It is specially designed for apparatus in which a carbon fits to slide in a guide, and consists in forming the carbon with a recess adapted to receive the end of a spring arm in order to hold the carbon in or out of operative position.

Electric Switches.

2748.—1910. CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee, U.S.A. The invention is particularly applicable to motor controllers of the type in which the brush is carried by a vibratory or radial arm and in which a low voltage coil under the control of the operator is employed to limit, through pawl and ratchet mechanism, the operation of the switch. In order that the low voltage device may be rendered inoperative at the will of the operator while the switch is being moved so that the switch may work freely the brush carrying arm is provided with means for directly short circuiting the low voltage magnet.

Electric Cab Controlling System for Railways.

3637.—1910. H. D. PATTERSON, Mount Vernon, U.S.A. In this system a source of alternating potential, a translating device, an electro magnetic controlling device and a condenser for off-setting inductance are all electrically connected and carried by the cab. The traffic control of the translating device is effected by reducing the reluctance and at the same time dissipating electric energy supplied from the magnetic circuit of the device by a transformer action according to danger or safety traffic conditions.

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PUBLICITY.

In this Section of "The Electrical Engineer," we give Publicity to New Inventions and Specialities.

GLOBE-CARRYING CLIPS.

One of the season's novelties being introduced by Messrs. Siemens Brothers Dynamo Works, Ltd., is a decidedly useful type of lantern for enclosing clusters of globe lamps. Fig. 1 shows the apparatus complete, and it will be seen

FIG. 1.

that it is of handsome appearance. The real novelty, however, consists in the globe-carrying clips, which have been devised so as to ensure safety and yet give ease in manipulation. In order to remove the globe, it is merely

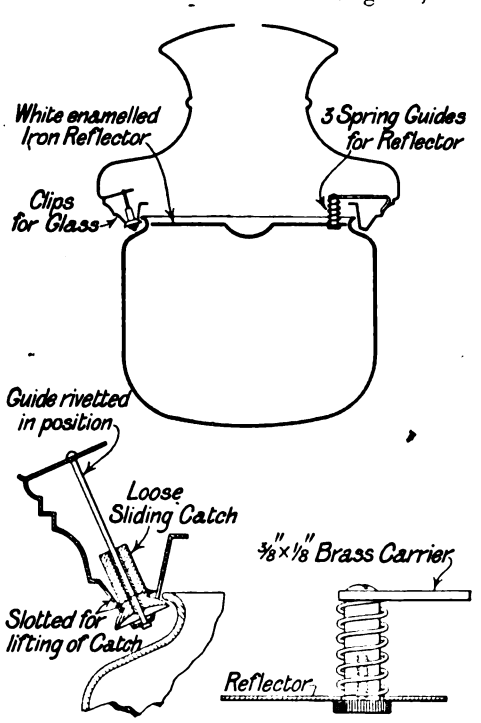

FIG. 2.

necessary to push it up, tilt it to one side, and the whole comes away bodily. Fig. 2 shows the details of the carrier, and it will be seen at a glance how easy it is to either remove or replace the globe in position. There is practically nothing to get out of order, so the whole process of tending such lanterns, for cleaning or renewals, is carried out quickly and without trouble. The reflector is mounted on springs, by which means all possible shock to the lamps is avoided.

PRICE OF CARBON FILAMENT LAMPS.

Messrs. Siemens Brothers Dynamo Works, Ltd., Tyssen-street, Dalston, London, N.E., inform us that they have recently reduced their prices for carbon filament lamps to the trade, and will be pleased to quote higher discounts than formerly on the lamps catalogued in their price list 21D. Messrs. Siemens inform us that the sales of these lamps are very rapidly increasing, and we advise contractors, etc., to enquire from Messrs. Siemens Brothers before placing their orders for these lamps. We are informed that very large stocks are held, and it is hardly necessary to point out the excellent quality of all lamps associated with the name of "Siemens."

HOLBORN STREET LIGHTING.

Incidentally upon consideration of improvements in street lighting by the Holborn Borough Council, a very valuable testimony came up in favour of electric lighting. At present Holborn is lighted by gas, and a deputation waited upon the Council, urging the need of improvements, and strongly supporting that the street lighting should be brought up to date by being changed over to electricity. The deputation was headed by Mr. A. W. Gamage, who made a very forceful speech, strongly supporting electricity for street lighting. The testimony is especially valuable, coming, as it does, from one who is perhaps unsurpassed as an exponent of up-to-date business methods, and whose successful achievements quite properly give his utterances the weight of authority. Mr. Gamage said that he held no brief for Electric Light or Gas Companies, nor had he any interest in either. He simply spoke out of his experience as a large consumer of electric light, as his business spent over £3,000 per annum on electric light. He maintained that electric light penetrated fog better than gas. Walking from Chancery-lane to Oxford-circus (which is electrically lighted), Mr. Gamage said was like stepping from darkness into sunshine. Where they had light they were bound to get the public. To find the value of electricity over gas, they had only to take the Borough of St. Marylebone: during the past year they had changed a part of their street lighting from gas to electricity and effected a saving of £1,500. Mr. Gamage went on to ask what would be the opinion of him if he lighted his up-to-date premises with farthing dips instead of electric light. This, he considered to be the case in Holborn. They were lighting the streets with dips instead of modern lights. Light meant prosperity for the tradespeople of Holborn, and where there was prosperity there was happiness.

BELFAST ELECTRICITY EXHIBITION.—The Corporation are going to hold an exhibition of heating, cooking, lighting and power appliances at the Ulster Hall, from January 9 to 21. Particulars of their enterprise will be found among our official advertisements.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

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NOTES.

Electrical Progress.

Mr. J. S. Peck's inaugural address before the Manchester Local Section of the Institution of Electrical Engineers was altogether an excellent performance. Quite apart from the interesting comparison of American and German methods with those prevailing over here, the address was most useful, for it dwelt on certain general tendencies of great importance, yet which are apt to be overlooked. His remarks on technical education deserve most careful consideration, not so much from educational authorities as from manufacturers. It is possible, as some critics aver, that in American and Continental colleges teaching is on far more practical lines than it is with us, but that does not lie at the root of the difficulty our past students find in securing posts with manufacturing firms. Both in America and Germany there is a greater appreciation of the benefits to be derived by manufacturers employing graduates of professional schools. Consequently there is a greater readiness to employ men leaving the class-rooms, and as a result the influence of manufacturers is more felt in educational circles, with benefit all round.

Students, Men of the Future.

A practical illustration of how the student of to-day may influence industry to-morrow is afforded by the fact that foreign and colonial students studying in schools necessarily acquire a bias in favour of the methods in which they are trained and for the appliances they use. Now this has brought both the Germans and Americans good business. So excellent are the teaching methods of Germany and America, that young men from all parts of the world join their schools, and when ultimately they go home, when the opportunity occurs, they order machinery and appliances from Germany or America as the case may be. The German and American technical schools in educating professional men are also training unconscious commercial ambassadors for their respective industries. We see this to some degree ourselves, for many fine orders for Eastern equipment are the result of Orientals having been trained over here. The pity is that we have allowed ourselves to be outdistanced in the perfection of technical education by other nations; consequently we do not attract the same number of young fellows from overseas as our keen rivals in business do. It will thus be seen that there is more in technical education than the average business person generally allows for.

International Exhibitions.

At last we appear to have secured something like an adequate organisation to look after British interests at International Exhibitions. The old method of appointing Royal Commissions, composed of an unwieldly, heterogeneous body, with usually that most inappropriate person, an old soldier, as chief executive officer, has gone, let us hope for ever. The Commissioners were all very well for purely ceremonial purposes, and may remain so; but the old soldier was invariably a nuisance and totally incompetent for the work in hand. Consequently British industrial interests have always suffered at exhibitions abroad. With the Exhibitions Branch of the Board of Trade, however, we have had a bold attempt, and a not unsuccessful attempt, to organise matters on a business footing. Thanks to this new body, we have done excellently at Brussels, Buenos Ayres and Vienna, while early preparations are being made for proper representation at other shows.

Business Results.

In the "Board of Trade Journal" some convincing information is given on the work of the Exhibitions Branch. We are told that "In each of the exhibitions named the British exhibitor appears to have been well rewarded for his enterprise. Never before has he been enabled to exhibit under conditions so advantageous. For the first time in the history of this country he has had at his disposal a Government organisation which almost entirely relieves him of anxiety and responsibility. To the fullest extent possible, his interests are safe-guarded. All available information is placed at his service, and facilities are given him to secure an increase of business for his own and the nation's good. There has recently been a considerable improvement in our trade returns. While such improvement may be traceable to many different causes, there is no doubt that the advertisement of British goods in foreign countries by means of the exhibitions referred to will be invaluable in maintaining and increasing British commerce. The fact that official participation in these exhibitions is not sanctioned until it is clear there is an immediate likelihood of Britishers securing distinct commercial advantage from a display of their goods, as well as the record of results already obtained, should in future prove to be a great incentive to the best firms to take part in similar enterprises under Government control. More particularly should this be the case with regard to the approaching Turin Exhibition, for, from Consular and other reports received, it is evident the Italian market is full of promise for the English, Irish and Scotch manufacturers. Some years ago His Majesty, King George, appealed to the British people to shake off their sloth. There are now striking evidences of a commercial stirring. Before long, and in view of prospective international exhibitions, it is to be hoped they will in truth 'wake up.'"

BENGAL-NAGPUR RAILWAY ELECTRICAL DEPARTMENT.

The Electrical Department of the Bengal-Nagpur Railway was recently augmented with two additional appointments, namely, an Assistant Electrical Engineer on a maximum salary of Rs. 600 per mensem, and an Electrician on a maximum salary of Rs. 400 per mensem. "Indian Engineering" states that the pay of the present Electricians was also increased from Rs. 400 to Rs. 450 per mensem, and the Electrician at Kidderpore is allowed free quarters. Mr. W. B. Davidson has, we hear, been selected for the new additional post of Electrician on a salary of Rs. 300 per mensem. He came out about a year ago on behalf of the Chloride Electric Storage Company, Ltd., in connection with the installation and working of their accumulator cells for the Bengal-Nagpur Railway at Khargpur, and he was previously employed on the Great North of Scotland Railway. In addition to the numerous electrical installations at Khargpur, Kidderpore, Shalimar, etc., the Bengal-Nagpur Railway are, we believe, extending their electric train lighting system. They had on December 31, 1909, only 43 of their coaching vehicles fitted for electric lighting on Stone's system, while 987 passenger vehicles were fitted with gas lighting on Pintsch's patent system. It is understood, however, that future new vehicles will be fitted with electric lighting.

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ANDRÉ MARIE AMPÉRE.

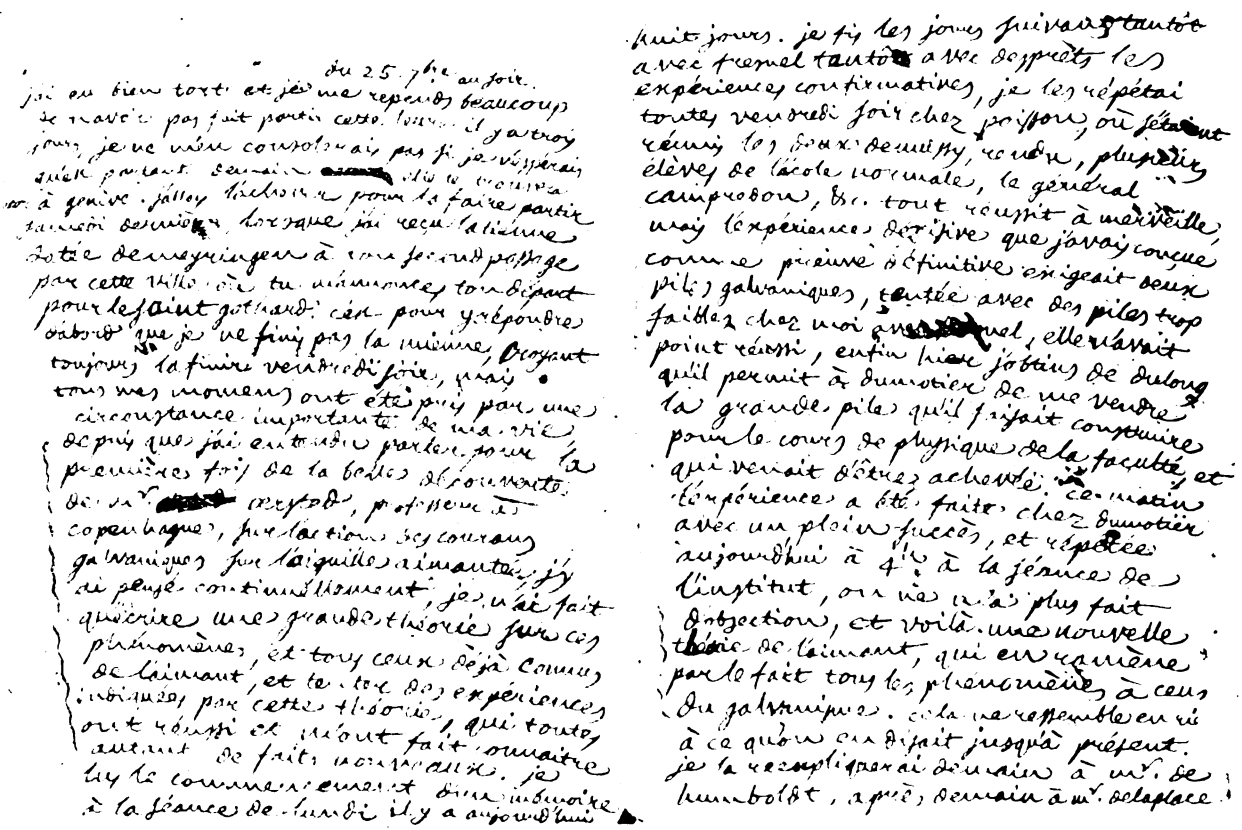
Valuable Letters Recovered after 35 Years.

We are enabled to publish particulars of an interesting discovery, and give the *facsimile* of a hitherto unprinted letter of André Marie Ampère (1775–1836), the great French natural philosopher, whose name was given to the electrical unit of intensity, and who was author of numerous very valuable contributions to the different scientific publications of his day. It will be remembered that in 1820, six years after his admission to the Institut de France, he presented a particularly noteworthy paper to the Académie des Sciences as a result of his investigations of Oersted's brilliant discovery. As Ampère himself has stated in the pages we here reproduce, he studied and multiplied Oersted's experiments before the learned men of his time until proof conclusive was obtained of findings which enabled him at last to announce his discovery of electro-dynamics that was destined to render him famous.

It was well said, a few years ago, that by Ampère alone was the complex and apparently inextricable action of the electric and magnetic currents first analyzed and classified under the conviction of an elementary law, and that nothing has occurred since to change or shake one syllable of his original definitions. Through his beautiful theory of molecular currents, he gave a theoretical explanation of the connection between electricity and magnetism which had been the dream of previous investigators. And it can be truthfully stated that if we except the discovery of the laws of the induction of electric currents, made some ten years later by Faraday, no advance in the science of electricity can compare for brilliancy and completeness with the great work that Ampère accomplished.

He always wrote extensively to many of his numerous friends about all his researches, which he was wont to detail in the most interesting manner, but to no one did he do so more genially and more acceptably than in the letters he frequently addressed to his only child, the antiquarian librarian, Jean Jacques Ampère (1800–1864), for whom his paternal affection was of the very greatest. This is evidenced throughout the two volumes of Ampère correspondence published in Paris during the year 1875. Amongst the letters therein will be found, more particularly, one from J. J. Ampère dated Geneva, September 23, 1820, which acknowledges a letter of his father announcing the discovery of electro-dynamics (*félicitations filiales*); also one, dated Paris, October 8th, 1826, from André Marie Ampère to his son informing him that, as Mr. Herschell spoke to Mr. Wollaston of his researches and had expressed a desire to witness them, he would renew the experiments on the day following. In this last-named letter he alludes to the forthcoming publication of his memoir on electro-dynamic phenomena. These volumes do not, however, contain the letters which are the subject of the present article. They are three in number, and were addressed by Ampère to his son under dates: Amiens, July 29 1820, four pages; Paris, August 6, 1820, four pages; Paris, September 19, 1820, one page, with the addition of three more pages written six days later, *i.e.*, September 25, 1820.

The three letters here alluded to were unexpectedly received not long since by Mr. Gaston Darboux, Sécrétaire Perpétuel de l'Académie des Sciences, who presented them to the latter body on August 1 of the present year. We are informed by this very gracious official that the letters came to him from Mr. Michel Chassagny, Inspecteur Général de l'Instruction Publique, 16 rue Gustave Zede Passy, by request of the widow of Mr. Joubert, who was also General Inspector of Public Instruction, and to whom they had been loaned 35 *years ago* by the Academy for a work on Ampère which Mr. Joubert then had in contemplation. The letters were but recently discovered in the library of Mr. Joubert, by his sister, Madame Georges Joubert, who happened to know of the circumstances under which they originally were obtained of the Academy, else they might have remained still longer absent from their legitimate custodians.



Whilst unusual interest attaches very naturally to everything written by the eminent scientist, we cannot give space to a reproduction, much less to a translation, of the numerous pages specified above. We think we will amply satisfy the curiosity of our readers if we but give two of the pages, which we have been allowed to photograph *exclusively*, and if we render besides the translation of these two pages which were written by Ampère under date September 25, 1820. The translation is as follows:—

It was quite wrong of me, and I regret very much not having mailed this letter three days ago. I would not be content (*ne m'en consolerais pas*) were I not in hopes that when leaving to-morrow, my letter will still find you in Geneva. I was about finishing it so as to have it go last Saturday, when I received the letter you wrote

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from Meyringen, upon your second visit to that city, wherein you announce your intended departure for the St. Gothard. It is preferably to acknowledge your letter that I do not now continue my own, hoping still to finish it on Friday evening; every moment of my time has been taken by what is to me an important life event. Since I first heard of the fine discovery by Mr. Oersted, Professor at Copenhagen, of the action of galvanic currents upon the magnetic needle, I have continually given it thought. I have written much and have framed a great theory upon these phenomena, as well as upon all those previously known of the magnet, besides making experiments suggested by that theory which have all been successful and have acquainted me with many new results. I read the beginning of a memoir at Monday's sitting (of the Academy) eight days ago. During the subsequent days, sometimes with Fresnel (1) and sometimes with Despretz (2), I made confirmatory experiments. On Friday I repeated them all at the residence of Poisson (3), where had met the two De Mussy (4), several students of the Normal School, General Campredon (5), etc. Everything succeeded marvellously well, but the decisive experiment, which I had conceived as conveying proof conclusive, required two galvanic batteries. When I attempted this experiment at home in presence of Fresnel, it had not succeeded, for my batteries were too weak. Yesterday, however, I obtained of Dulong (6) leave to buy of Dumotier the large battery constructed for the course of natural philosophy at the Faculty, and which he had just finished. This morning the experiment was made at the house of Dumotier with great success, and it was repeated, four o'clock to-day, at the sitting of the Institute. No more questions were raised, and now we have a new theory on the magnet which in reality shows that all its phenomena hold close relationship to those of galvanism (or identifying all its phenomena with those of galvanism). This resembles in no wise (is totally unlike) all heretofore said of it. I will explain it anew to-morrow to Mr. de Humboldt (7), and after to-morrow to Mr. de la Place (8) at the Bureau des Longitudes. . . . Your father embraces you many thousand times. Signed, A. AMPERE.

We do not think it necessary to detail here the numerous epoch-making papers which Ampére has brought to the notice of learned bodies, touching the above-named as well as his other discoveries. They will all be found recorded in the encyclopædias, as well as in the special works which, at the time, his remarkable researches called for throughout the entire scientific world.

PERSONAL.

Mr. P. J. Pringle, Borough Electrical Engineer, Burton, and tramway manager, has resigned to take up a post in Australia.

Mr. J. H. Winch, of the electrical fitters department, Sheerness Dockyard, has been sent to Birmingham on Admiralty overseering duty.

Mr. W. A. Turnbull, late chief assistant electrical engineer to the Corporation of York, has been appointed assistant resident electrical engineer at Stoke-on-Trent.

Mr. E. A. Laidlaw, electrical engineer, has resigned his post with the National Telephone Company to take charge of the telephone department of Messrs. Siemens Brothers & Company, Ltd., at Woolwich.

Mr. Alexander Turnbull, founder and managing director of Alexander Turnbull & Company, Ltd., having retired, Mr. John M. Johnson has been appointed general manager. Mr. Turnbull retains the chairmanship and will act as technical adviser to the board.

(1) Fresnel (Augustin, Jean), French physicist, 1788-1827.
(2) Despretz (César Mansuète), French physicist, 1789-1863.
(3) Poisson (Siméon Denis), French mathematician, 1781-1840.
(4) Mussy (François, Gueneau de), French doctor, 1774-1857, and (Philibert, Gueneau de), French author, 1776-1834.
(5) Campredon (Jacques D. M. de), French general, 1761-1837.
(6) Dulong (Pierre Louis), French chemist and physicist, 1785-1858.
(7) Humboldt (F. N. Alexander Von), German naturalist, 1769-1859.
(8) La Place (Pierre Simon de), celebrated French geometer, President of the Bureau des Longitudes, 1749-1827.

MANCHESTER ENGINEERING AND MACHINERY EXHIBITION, 1910.

Third Notice.

J. Marse & Company, who are the English agents for several French firms, show a very interesting Hydro-electric rivetting machine, constructed by A. Piat et Cie. This rivetter is made in many sizes and for all classes of work. The principle on which it works is novel. The main frame C (see diagram, page 311, Sept. 16) is of cast steel and carries the two snaps A and B at the outer end. B is fixed, while A is fitted on the end of a ram sliding within the cylinder D. There is also a smaller cylinder E, fitted with a spiral spring for the return motion of the ram.

The cylinder D is connected by a copper pipe M to the compression cylinder F situated at the bottom of the machine. Working in F is a piston G, having the upper portion H of its rod square-threaded. Mounted on the main frame is the electric motor J, which, through the pinion K, turns the wheel L. L runs on roller bearings and its shaft is hollow and threaded inside to take the screw H. The piston G being forced down, the water in F passes through the pipe M to the cylinder D, and in turn forces the ram A down, closing the rivet between it and B.

Fitted to the top of the cylinder D is a small reservoir "A," from which any loss in the water is made good. Valve N forms the connection between D and "A." The pressure obtained is indicated on the gauge O.

The motor control is extremely simple. There is a small built-in switch P (having oil immersed contacts), operated by handle Q. By simply raising Q the handbrake R on the motor shaft is removed, the circuit is closed through P, and the motor commences to compress the water in F, bringing down A. As soon as Q is brought back to the central position the current is cut off and brake R applied. The reverse movement of raising A is obtained by depressing Q. To make certain that the current is cut off at the right instant, an automatic tripgear is provided on a vertical shaft connected by mitre gears to the shaft of Q. Two cams TT may be clamped in any desired position on this vertical shaft. The inclined faces of these cams stand in the path of a small wheel carried on the guide collar M. When the ram A is descending the small wheel encounters the lower cam, and immediately cuts off the current and applies the brake R, the ram A expending its energy in closing the rivet. On the handle Q being depressed the ram rises, and the wheel on U encounters the upper cam and again the motor is stopped. To facilitate handling the machine is suspended from a hanger V, fitted with ball bearings. It is claimed that a $\frac{7}{8}$" rivet is closed in from 5 to 6 seconds, and that 400 may be closed in one hour, with the assistance of one man and two boys. The current consumption is very low and 240 1" rivets may be closed for one unit. The dimensions on the drawing refer to the type D No. 2 and the motor is 2½ h.p.

No skilled labour is needed to work the rivetter, which is so simply constructed that it cannot well get out of order. The water may be replaced by a non-freezing mixture for use in all weathers. This machine has proved highly successful on the Continent and is used by many of the largest firms there.

Other exhibits shown by Messrs. Marse & Company are some "Piat" cast iron gear wheels direct from the sand and ready for use. These, again, are of French production.

A "Jost" High Speed Drilling Machine is shown, capable of drilling from $\frac{1}{32}$" to 2", and of boring up to 4" in cast iron. By an oil immersed change speed gear 12 spindle speeds are obtained. The feed is variable through friction driving.

At the stand of William Boby are to be seen two examples of continuous water softening machines, together with numerous photographs of installations already carried out. With the type "B" Simplex softener, which shows a form of construction adopted for all sizes from 250 gallons per hour upwards; chemical re-agent solution is employed in the form of milk of

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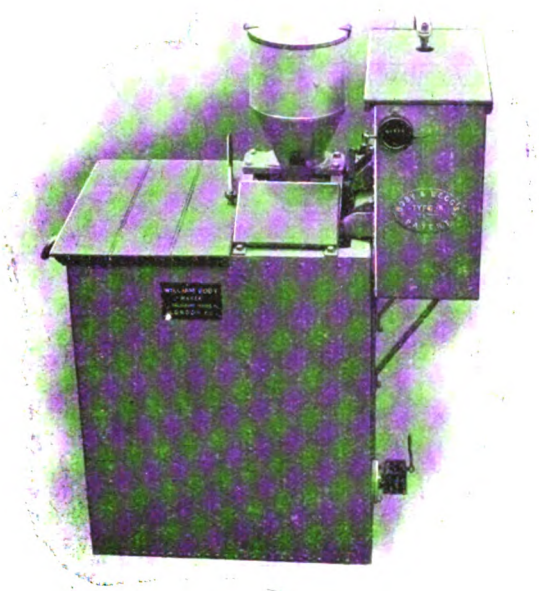
lime and soda; the device by which the water and chemical solution is measured being designed to give a high degree of accuracy under all working conditions.

The special feature of the type "K" softener, which is also exhibited, is that chemical solutions are dispensed with, the re-agents being distributed to the water in the form of powder from a canister placed on the top of the tank. Thus a special prescription may be made up for the particular water and given to it in doses, automatically, with little labour and accurate results. The water softeners are each fitted with an indicator, recording the quantity of water treated. At this stand may also be had particulars of Fletcher's improved system of steam generation, which will be fully described in our next issue.



Boby Water Softener

The Timbrel and Wright Machine Tool and Engineering Company, Ltd., Birmingham, who have specialised on small capstans for making parts for electrical apparatus, gas and water fittings, etc., show some very high speed machines at work. They claim that theirs are the fastest running machines of their kind on the market and they are prepared to guarantee the outputs.

At the stand of Messrs. Richard Klinger & Company may be seen a very full line of improved gauge cocks and lubricators, as well as their stuffing box packing, which has been attracting considerable attention. The body of the packing consists of (1) a special fibrous lubricant embedded in which is (2) a perforated strip of flexible metal, and the whole is encased in (3) an interlaced cotton covering, one side of which is coloured red to show that that side must be placed directly in contact with the piston rod. The metal strip, being flexible, may be readily bent round any diameter of valve spindle or piston rod, and the lubricant material being forced through the perforations by the pressure of the gland forms a perfectly tight joint. By tightening the stuffing box from time to time a fresh supply of lubricant is forced through the perforations, so keeping the joint always tight, and also automatically lubricating the piston rod. As the packing is made up of a number of rings it is resilient throughout the whole length of the stuffing box. Then there is the famous "Klingerit" sheet jointing, which is known and used all over the world. A new form of this has recently been brought out—the sheets cut up into long narrow strips and sold as "Klingerit" Tape. This is particularly useful for manhole or handhole joints.

The Patent File and Tool Company, Ltd.'s stand has much to interest the manufacturer. Here are to be seen the "Dreadnought" Files, which are quite a departure from the time-honoured file which is so familiar. As will be seen on reference to the drawing, the teeth, instead of being points, are semi-circular in shape, extending from side to side of the file, and cut specially deep. In use they have a drawing or shearing action after the manner of a milling cutter. This action, which can easily be proved to be theoretically correct, is, of course, quite different from that of an ordinary file. Every metal, and many other substances, such as marble, wood, horn, etc., is cut by these files, leaving an absolutely smooth and finished surface. The cutting power is very great and the life very long, and owing to the shape of the teeth they do not clog. Re-sharpening is very easy, and by using the firm's patent sharpening machine a blunt file can be made equal to new at a very small cost. Tests are continually being carried out on a Herbert's file-testing machine to prove the claims made.

Another exhibit is the "Dreadnought" Rail Planer, which is to be seen at work. This is an application of the file principle.

W. Kennedy, West Drayton, Middlesex, shows the well-known Kennedy Patent Bending Machine, which will bend, cold and unloaded, copper, iron and steel tubes up to 2″ diameter. It may also be used for angle, tee, channel and other sections and for bending copper strips up for coils. There is also a good selection of the Taylor Spiral Self-Centreing Chuck.

The Pistonless Hydraulic Press Company, Ltd., London, E.C., have several presses on view, and provide the crowd with plenty of demonstrations, which never fail to please. These presses, which are specially suitable for light work, give from 3 to 50 tons pressure and are worked simply and directly from the ordinary water mains, without any pumps or other motive power. As will be seen on reference to the figure, the platen of the press is supported on an armoured collapsible cylinder. The low pressure water is directly admitted to this cylinder from the mains, causing the platen to rise, carrying the work with it, until the head of the press is reached, when the work is pressed. There is no ram as in an ordinary hydraulic press, with its attendant disadvantages. The initial cost of pistonless press is about one half that of the ram press, while as there are practically no moving parts its upkeep is very small indeed. The running costs are extremely low.

Pistonless Press.

Estler Bros., Eastcheap, E.C., show a line of steel storage bins, shelving and lockers, for engineering stores and all stock-keeping purposes. The patented construction adopted has enabled the cost to be brought down very low, until now it is about equal to that of similar wooden fixtures. To those firms who are beginning to feel the improvement in trade this stand will have special interest.

Clarke, Chapman & Company, Ltd., Gateshead, show a number of photographs of their productions, including several of their electrical hauling machinery, searchlight projectors, etc. There are also several models, including one of the well-known Woodeson patent boiler, which is so well-known to station engineers.

C. Redman & Sons, Halifax, show a planing machine to plane 8 ft. long by 3 ft. square. Two tool boxes are provided on the cross slide and one on the standard. The machine is fitted with the Lancashire D. & M. Company's

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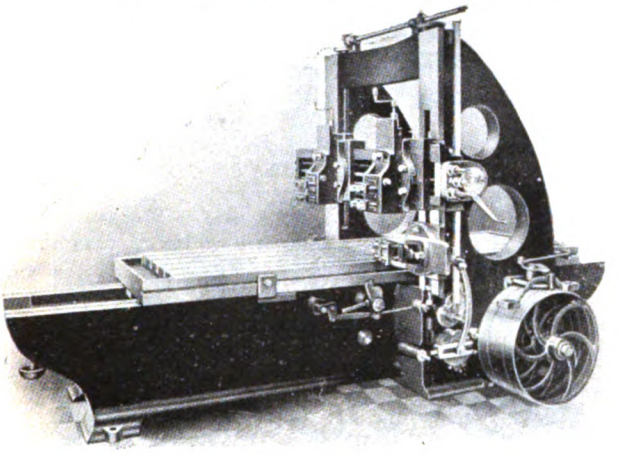
patent system of driving, by means of which any cutting speed between 20 ft. and 60 ft. per minute and any return speed from 150 ft. to 200 ft. per minute can be obtained, and the rate of either cutting or returning speed can be immediately changed whilst the machine is in motion. Advantage of this facility is fully taken on the machine exhibited, it being provided with a secondary set of dogs or tappits on the back edge of table, whereby in planing such work as bosses raised at a distance apart on the work, the speed of table is increased very much during the passage of the intervening spaces under the tool; in fact, these spaces are passed over at the speed of the return. The machine has been working on work of this kind during the exhibition, and has fully justified all the claims made for it. Although the machine is working on a raised boarded floor, without any foundations or holding down bolts, there is practically no noise in working, and no appearance of shock or jar as the tool meets the work. The system of driving which is adopted is an entirely new departure, and is due to the Lancashire D. & M. Company. The dis-

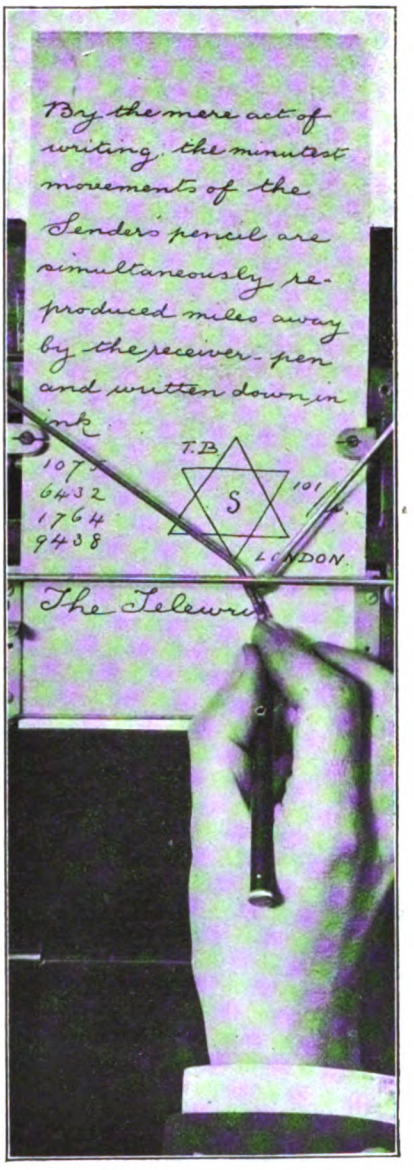


REDMAN PLANER.

advantages of the belt-driven high-speed planer are well-known. There is considerable slip and wear on the belts. Although the possession of a large and even variator in the cutting speeds is essential for the most economical working and best results, with the belt drive these changes can only be obtained by adding the complications inseparable from gear boxes. Even then the choice is very limited indeed. A very important point is that the point of reversal is uncertain. In many cases work must be planed to a line. With the belt drive, on intermittent work, the table jumps forward as the tool leaves the metal and enters upon the next cut at an excessive rate of speed, destroying the cutting edge of the tool. There are many other minor disadvantages, which all mean higher maintenance costs, higher depreciation costs, and higher production costs.

In the "Lancashire" system, the planer is coupled directly or through reduction gearing to a reversing motor. This motor derives its energy from a special generator, driven either by another motor running on the A.C. or D.C. supply mains, or belt-driven from the shafting. The planer motor and its generator are D.C. machines wound for any convenient voltage to suit the particular work. The only mechanical connection between the switchgear and the planer is a tappet rod, costing only a few shillings. This tappet rod is worked from the reversing gear of the planer, and actuates a small reversing switch, which changes the direction of the field current in the generator and so reverses the planer motor's rotation. At the same time it regulates the generator voltage (which, of course, decides the planer motor speed) to give any desired speed of cut or return. The cutting speed may be regulated by hand, by resistance in the generator field circuit. This is put in on the cut only, the maximum field being almost always used on return. Thus by merely adjusting the shunt regulator any desired speed of cut (which is only limited by the tool strength) from, say, 15 ft. per minute to the maximum is at once obtained. The system is a truly regenerative one, as the energy stored in the plane bed and its load is returned to the line through the motor generator set, from the planer motor which, of course, at the instant of reversal, becomes a generator. This saves power, but also gives a very powerful braking effect, which causes the motor to reverse instantaneously, thus securing a constant point of reversal on the work. The switchgear required is simply that for an ordinary variable speed motor, and it is neatly made up in shorter panel form. During operation only the shunt breaking switch of the generator moves. This switch may, if desired, be tripped from small switches placed on the frame at various points.

Briefly, the points of the "Lancashire" system are: (1) that there are no belts used at all—this item alone will often mean a saving of £80–£100 a year in upkeep; (2) that any cutting speed may be obtained between the limits; (3) that owing to the brake effect, planing to a line is always accomplished (see blocks); (4) there is perfect steadiness and no jumping of the bed; (5) the electrical



TELEWRITER: DISPATCHING.

gear is of the very simplest description; (6) there is no wasted time caused by belt slip. Some tests recently made of an 18 ft. by 6 ft. square planer, whose bed and load weighed 11 tons, showed that with a length of stroke of 15 ft., at a speed of 54 ft. per second, there was only 1·8 second lost per cycle, that is cut and return; (7) the return speed being higher than that obtained by any other system, the time during which the planer is not doing useful work is reduced to the very smallest amount; (8) by the system very short strokes, even down to 2 inches, can be done if the planer mechanism is suitable; (9) the power consumption is reduced to the very lowest amount. The curve shows that the system is truly regenerative. For the test to which the curve relates, the cutting speed was 80 ft. per minute, and the return 160 ft. per minute. During the time for which the diagram is shown, two ½ inch by 1-16th inch cuts were

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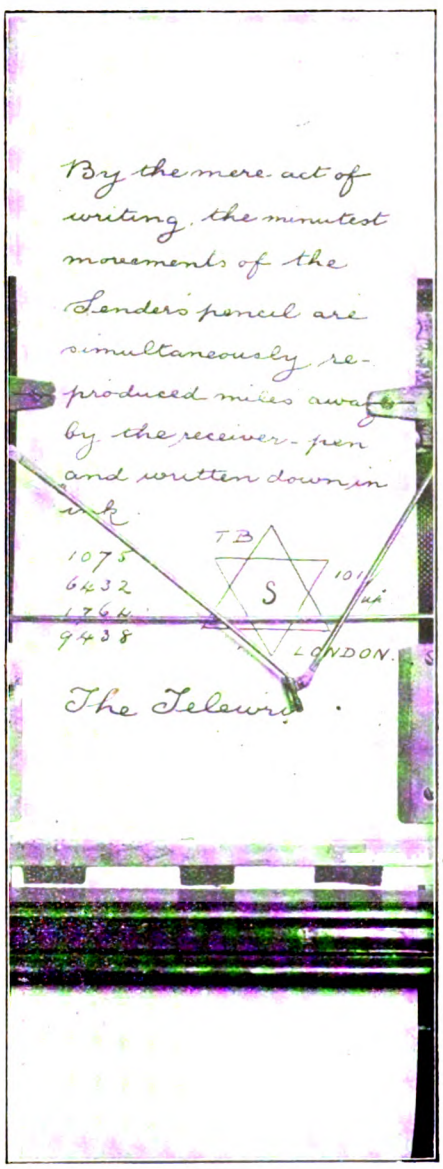
being made in mild steel, with 18 ft. stroke. While ideal for new planers, the system may be applied equally well to old machines, the speeds being limited only by the strength of the parts. There is no doubt this system has a great future before it, and the fact that Messrs. Redman & Sons, who are the acknowledged leaders in planer construction, have taken it up, speaks volumes as to its practical value.

Messrs. Redman also show an 8½ inch centre 8-ft. gap head for cutting lathe, which, while not of the ultra high-speed variety, is capable of taking quite heavy cuts at 40 ft. per minute. This is one of the large series of lathes which Redmans' have developed for everyday use. All the gearing is carefully machine cut, and efficient guards are provided. The lathe has three-speed feed, instantly changeable by hand lever on the American principle; while in conjunction with the double overbend motion supplied,



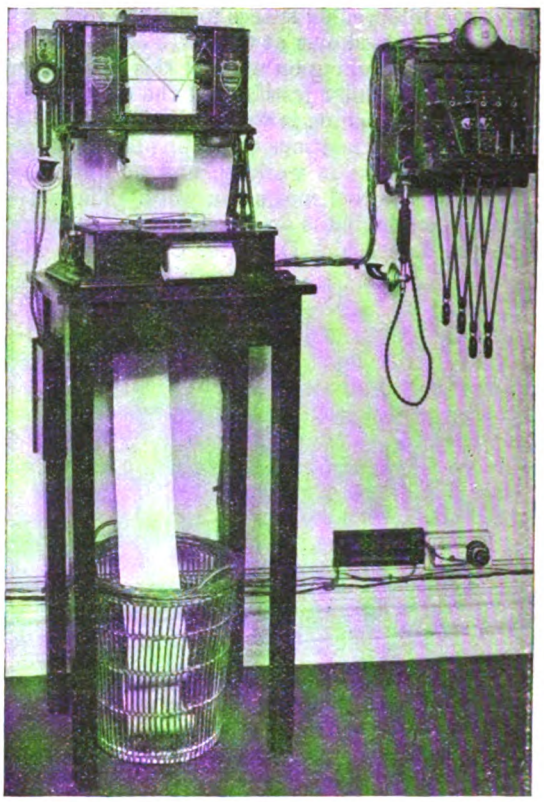
TELEWRITER: RECEIVING.

six ungeared speeds and six geared speeds may be obtained.

The telewriter has never failed to attract a wondering crowd; in fact, with the non-technical it seriously rivalled the bar in popularity.

Two instruments are rigged up about 10 ft. apart, connected by an artificial line, so that the instruments are working under the same conditions as if they were separated a distance of 20 miles.

The Telewriter can be connected to any private line or indoor lines, and by its means sketches, written orders, etc., can be instantly transmitted between the offices and the shop, by the mere act of sketching or writing the first copy in the office on the telewriter desk. There is no complicated switchboard. The working is simplicity itself, the act of lifting the receiver connects the user with the telephone, hanging it up again on the rest connects the telewriter. The telewriter and the telephone never clash in their use. This ingenious instrument is an indispensable adjunct to the works telephone, or to the private line between the sales department and the works. It is noteworthy that the Telewriter Exchange which was opened in London last July with 40 subscribers, has now about 200, and is rapidly making further additions. In the Manchester district the instrument is being taken up very quickly. The standard terms are to hire out the instruments and maintain them at £14 per annum per pair for indoor



TELEWRITER AND TELEPHONE INSTALLATION.

work. For outdoor, the instruments being three miles apart, the cost is £20 per annum per pair, with £1 per annum per pair for every additional mile over three miles The instruments may also be purchased outright at a price depending on the work they have to perform.

Reference to sketches gives some idea of the outward appearance of the instruments and of the manner in which they work. The internal mechanism consists of two small motors, the field of the recorder being varied by the motion of the pantograph attached to the writer's pencil to reproduce all the movements on the receiving instrument.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "The Editor, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

ELECTRIC LIGHT FOR WORKMEN'S DWELLINGS.

To the Editor, "Electrical Engineer."

Sir,—A number of very misleading reports have recently appeared in the various daily newspapers regarding the experimental electric lighting of workmen's dwelling-houses recently carried out by the Eccles Corporation. The following particulars may, therefore, be of interest to your readers:—

As the above class of property greatly predominates in the Borough of Eccles, it presents a wide field of business, provided it can be catered for on reasonable terms. The object, therefore, of the experiment which has been carried out during the past 12 months was to ascertain whether the supply of electrical energy for such a purpose could be given on profitable terms by the Corporation, and at

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the same time at a cost to the user that would encourage the general use of electric lighting in this class of property. Previous results obtained in Eccles when supplying this class of house with eight metal filament lamps installed has shown that the income for the electrical energy consumed, when charged for at the Corporation's standard price per Board of Trade unit, approximately amounts to 26s. (twenty-six shillings) per house per annum. With so small an annual income, it is, of course, evident that such business would not prove remunerative to the Corporation should they have to incur the expense of a separate meter and service for each house, and also low-tension distributing mains. If, however, the landlords of such property would instal in rows of similar houses electric light wiring, fittings, and distributing mains, and obtain from the Corporation at their standard rate of charge a bulk supply of electrical energy, it is possible that the cost of the electrical energy consumed by the normal use of the electric light would be covered by a charge of 6d. per week on each of the tenants.

An opportunity to ascertain whether such is the case presented itself when the Eccles Corporation Health Committee were erecting a block of 12 workmen's cottages.

It was suggested to the Health Committee that they should instal electric light wiring, fittings, and low-tension distributing main in this property, and the Electricity Committee offered to supply to the Health Committee, through one service and meter, the electrical energy required by the 12 houses at such a price per unit as would enable them, without loss to themselves, to charge each of their tenants at the rate of 6d. per week for the use of the supply, subject to the following conditions :—

CORPORATION ROAD HOUSES.

CONDITIONS OF SUPPLY OF ELECTRIC LIGHT.

1.—The charge for electric light provides for the normal use of same. When rooms are not being used, the electric light must be switched off, and no lamps are to be left burning after tenants have retired to bed at night, or during the hours of daylight.

If the above conditions are found to be infringed, an extra charge will be made for the excess consumption of electrical energy.

It is to be remembered that the more the lamps are burned, the sooner they will give out and require renewing.

2.—When any lamp requires to be renewed, a written order is to be sent to the Borough Electrical Engineer, Electricity Works, Cawdor-street, Patricroft, and the lamp will be supplied and fixed at the following prices :—

32 c.p., 2s. 9d. each.
16 c.p., 2s. 6d. each.
12 c.p., 2s. 6d. each.

Amounts due for lamps supplied must be paid to the Borough Collector by the following Monday.

The renewal of lamps will only be carried out between the hours of 9 a.m. to 5 p.m. on Monday to Friday inclusive, and on Saturday, 9 a.m. to 12 noon.

3.—No other lamps but those supplied by the Borough Electrical Engineer are to be used.

4.—Tenants must not remove any lamp and use it in another room, or replace a lamp with one of their own.

5.—Tenants must not interfere with, remove, or replace any fittings without written permission to do so from the Borough Electrical Engineer.

6.—Infringement of Conditions 3, 4 and 5 may render the tenant liable to prosecution.

7.—Officials of the Corporation Electricity Department are to be entitled at all reasonable times to enter the houses for the purpose of inspecting the fittings, lamps, wiring, etc.

This suggestion was accepted, and the following is the general arrangement of wiring and fittings that was installed in the houses :—

The Electricity Committee's service cable was taken into one of the houses in the middle of the row, and the meter, main fuses, etc., fixed at this point. The remaining work inside the property was carried out by the Health Committee, and consisted of installing an auto transformer, reducing the pressure of the supply from 200 volts to 50 volts, from the terminals of which a distributing main was run through the cock lofts of the houses, and from this distributing main services were run to the various houses. The wiring in the houses was run throughout in wood casing, and every lamp was provided with a separate switch fixed on the wall. A paper seal was fixed to each lampholder and lamp, so that no lamp could be removed without detection.

The following is a schedule of the lights installed in each house :—

Ground Floor—

Entrance hall	..	1—12 c.p. 13 watt lamp.
Parlour	..	1—32 c.p. 35 watt lamp.
Kitchen	..	1—32 c.p. 35 watt lamp.
Scullery	..	1—12 c.p. 13 watt lamp.

First Floor—

Bedroom No. 1	..	1—16 c.p. 17 watt lamp.
Bedroom No. 2	..	1—12 c.p. 13 watt lamp.
Bedroom No. 3	..	1—12 c.p. 13 watt lamp.
Bathroom	..	1—12 c.p. 13 watt lamp.

The total cost to the Health Committee of the above wiring, fittings, lamps and auto transformer amounted to £61 10s. (sixty-one pounds, ten shillings).

The metered consumption for the first 12 months' supply to the above houses (all houses being tenanted throughout the period) amounted to 1,205 Board of Trade units, and in this figure is included the core loss of the auto transformer, which is permanently in circuit.

The Health Committee have been debited with the above consumption at an average price of 3·106d. per Board of Trade unit, which has enabled them to charge without loss each of their tenants 6d. per week for the use of the supply. The Electricity Committee's standard rates of charge for a supply of general lighting purposes are at the flat rate of 4d. per Board of Trade unit, or alternatively on the maximum demand system of 7d. (first hour) and 2d. If the above supply had been charged on the maximum demand system, it would have worked out as follows :—

Total metered consumption for the 12 months—1,205 B.T.U.

Maximum rate of demand—740 watts.

Therefore, 270 units would have been charged for at 7d. and 935 at 2d., which is equivalent to an average price of 3·12d. per B.T.U.

With reference to the cost of lamp renewals, which has to be borne by the tenants, this has not been a serious expense, as only nine new lamps were required in the above 12 houses during the 12 months.

The result of this experimental lighting has undoubtedly shown that under the above conditions the cost of electric lighting in workmen's dwelling-houses need not be an obstacle to its general adoption.

Any landlord may obtain a similar supply from the Corporation on the maximum demand system of charging, which will enable him, under like conditions to the above to offer his tenants similar terms to those offered by the Health Committee to their tenants.

Yours, etc.,
H. W. ANGUS,
Borough Electrical Engineer.

Eccles Corporation Electricity Works,
Cawdor-street, Patricroft, Lancashire,
November 1, 1910.

NORTH WALES IS THE IDEAL WINTER HEALTH RESORT.

The dry, mild, and equable climate peculiarly adapts this district for the relief of pulmonary and other disorders. Medical testimony endorses this, and statistics prove it. If you care to know more about North Wales as a Winter Resort, a postcard to Mr. G. T. Phizackerley, District Superintendent, Chester, or to the Enquiry Office, Euston Station, N.W., will bring you a booklet on the subject, or a copy may be obtained free on application to any London and North-Western Station or Town Office

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

A rather unfortunate incident in connection with the extraordinary general meeting of the Cleveland & Durham Electric Power Company, Ltd., recently in order to reduce the capital of the company from £1,000,000 to £700,000 was that some objection appeared to be taken to the amounts received or due to be received by the consulting engineers to the undertaking. It appears that one of the shareholders made the somewhat unique suggestion that the consulting engineers should be asked to refund part of the sums paid to them. This was not, of course, adopted, and the matter would hardly be worth referring to if it did not again raise that very debatable point, the amount of responsibility which a consulting engineer, who is admittedly a technical expert, has to or should take with respect to the ultimate financial success or otherwise of the undertaking for which he has consulted. Obviously there are many more considerations affecting such success, than that of the technical equipment, and while every inducement made to the consultant to place the technical in co-ordination with the financial section of the work is entirely in order, it is certainly not in the best interests of an undertaking that the consultant should have a more intimate connection with an undertaking than that implied by his position of adviser. This position would in every probability be impaired if any such suggestion as that made were adopted, and for this reason the matter is of interest to the whole of the electrical fraternity.

Strikes.

Still further symptoms of labour unrest are noticeable in Newcastle district. It will be remembered that the apprentices at Messrs. Clarke Chapman & Company, Ltd., of Gateshead, recently went out on strike under circumstances which are hard to understand as a cause for such an action. As a result largely of this the firm has decided to place its apprentices under indentures, making a payment of £3 obligatory on the apprentice in the winch and windlass department when receiving his indentures, and of £5 in the other sections. This money will be returned on completion of the indentures, but will be forfeitable in the event of an apprentice coming out on strike. This appears to have caused heartburnings, with the result that a considerable number of apprentices have "gone out," the majority, however, only for a very short period, it is to be hoped.

Newcastle Tramways.

It was reported in this column some time ago that numerous experiments were being tried on the Newcastle Corporation Tramway system and those services in connection with it. The general manager has now given a report to the Tramways Committee upon the way in which these schemes have operated in practice. The through return fares to Tynemouth and the seaside from the foot of Northumberland-street for ninepence has apparently worked sufficiently well to warrant further trial. During the summer months it is certainly apparent that the system would meet with favour. He also reports favourably on the cheap fares from Newcastle to Gosforth Park as practically doubling the number of passengers on that route. At the same meeting it was decided to issue books of tickets at "workmens" reduced fares, to such blind people as applied for them. This is the outcome of the recent agitation for free rides for the blind, to which the Corporation could not consent.

Marine Engineering and Shipbuilding.

Although shipbuilding, which is the staple industry on Tyneside and Wearside, on which electrical work and much else depends, is practically at a standstill, there are signs that when once the lock-out is over there will be a resumption of activity to a considerable extent. It is reported in the local press that an order for Messrs. Palmers Shipbuilding & Iron Company from the Ellerman line is rumoured. The "North Mail" also reports that the Furness line are proposing to build five vessels for the frozen and chilled meat trade, two of which are to be built on the Tyne. A vessel is also reported as having been ordered from Messrs. Doxford's, of Sunderland, for a new service between Scandinavia, South Africa and Australia. Moreover Sunderland's energetic M.P., Mr. James Knott, is busy with the propaganda work for the establishment of a minor naval base on the Wear. So that there is still a sporting chance for electricians in the North.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The observations which have been made in this district by members of the Institution of Mining Electrical Engineers upon the resistance of the human body to electric currents, and reported from time to time, came up for discussion at a meeting of the Warwickshire and South Staffordshire Branch held in Birmingham on Saturday last. With this discussion was combined one upon the paper given at a previous meeting by Mr. W. Foster, of the Littleton Collieries, in which were given some notes on earthing as well as on the resistance of the human body. On the latter, Mr. Foster had carried out 72 tests, the time for each being from 30 to 45 seconds, and the drop in the resistance at the end was attributed to the fact that the hand grasping the tube was then perspiring slightly. The examples of tests quoted included the following :—

No.	Volts.	Amps.	Ohms.	Volts.	Amps.	Ohms.
1	50	0·04	1250	110	0·120	916
11	20	0·036	555	74	0·22	336
21	26	0·078	333	66	0·3	220
31	16	0·066	242	55	0·3	183
41	16	0·066	242	51	0·276	185
51	16	0·072	222	48	0·3	160
61	16	0·066	242	42	0·23	183
71	16	0·072	222	36	0·25	144
72	16	0·12	133	32	0·3	107

Earth Contact and Human Resistance.

With regard to earth contact, the President (Mr. Arthur Hall) expressed agreement with Mr. Foster as to its value. Referring to a curve he had prepared on the subject of human body resistance, Mr. J. R. English (Walsall Wood Collieries) said that the curve was calculated up to 5,000 volts, and it was rather remarkable that such a large amount of current as 100 amperes could pass through an average person at that pressure. All the tests showed that there was a marked decrease in the resistance of the body as the pressure applied increased. It would be interesting to have a similar series of tests with alternating current, especially if they could be made at different frequencies. Mr. Foster had pointed out that the skin of the arm was punctured at about 20 volts, and had therefore advised that as persons might get a shock on a tenderer skin, such as that of the back of the hand, it would be advisable to keep the pressure in the earth system below 50 volts between any earthed metal work and earth. It was evident that 50 volts would give a very severe shock, and that the man in question would not stand 50 volts very well. With regard to the concentric system, Mr. English said that unless the system was well earthed all along the route there was more than a danger of shock, because the outer

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covering carried all the working current, and there was a considerable difference of potential at different points.

He did not agree with Mr. Foster as to the comparative valuelessness of an earth-plate for the in-bye motor. He thought a good earth-plate here would reduce, if not prevent, any possible sparking between the metallic return, and the effect would be to conduct a large portion of the current to the ground.

General Survey.

Mr. Foster, in reply, said that the system of earth distribution would no doubt be advantageous where the in-bye cables were used over very long distances, rather than being concentrated at a small point. He agreed with Mr. English that tests with alternating currents at different frequencies would be very useful. With regard to the person in the series of tests who was unable to stand 50 volts, it was explained in the paper that that person could not stand 20 volts applied suddenly. But 50 volts differently applied would not really be a danger to that person. It would give a fairly severe shock, but would not come anywhere near having a fatal effect. As to the concentric system, he believed that this would be all right if well earthed in regard to conductivity and continuity of earth. With regard to the earth-plate at the in-bye, he considered that with any proportion of resistance the earth-plate would have very little effect.

Examinations for Mining Engineers.

The question of examinations for mining electrical engineers was discussed. The President mentioned that a sub-committee had been appointed as the result of the discussion at the general conference at Newcastle, to prepare a model examination paper, but that had not yet been received. It appeared to him that a mining electrician if he knew all that he ought to know had to be in a lesser degree something like a colliery manager, a sort of jack-of-all-trades, and very nearly a master of them all. The great difficulty in his own experience had been to secure a man who was equally good in electricity and in mining. He agreed with Mr. Maurice, the President of the Institution, that such men at present were few and far between, but their association was calculated to produce them, and was doing so. Colliery installations varied very much in size, and a man accustomed to a small one would not be suitable for a large one without some previous probation. Another question was with regard to certificates for old hands who were useful practical men, but to whom it would be a hardship to have to pass a difficult theoretical examination. It was often the case that a man failed to obtain a certificate not because of want of practical competence but because of inexperience in putting his thoughts into writing. With regard to the period of exemption from examination in such cases he thought 12 months was sufficiently long to enable a man to make up his mind whether he wanted to be a member or not. In deciding upon the qualifications of a mining electrician, they must remember that he should know more than a bit of telephone work, a bit of wiring or jointing. The mining electrician might be required to exercise supervision over large installations under both systems of electrical supply.

Scope of the Society.

A suggestion was made as to an impression prevailing that the society existed exclusively for electricians. The President said they should disabuse the minds of their friends of that idea. In particular it was desirable to increase the membership in the associate classes. To some extent, the colliery section might educate the electrical section, and *vice versa*. Mr. Wilkes thought that the examination ought not to be restricted to electrical matters and that the time was not far distant when the electrical engineer would be merged into the general engineer and the mechanical man would of necessity have to be an electrical engineer. At the conclusion the meeting passed a resolution expressing general approval of Mr. Maurice's views on examination.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

Work in this district continues to increase at a rapid rate, and although prices are as a rule rather cut, there is every prospect that one or two local firms who have been conspicuous as non-dividend payers, will next year have to report a change for the better. There is a certain improvement in the cotton industry and many Lancashire mills which were either working half-time or were closed altogether, are now preparing to work full time again. At Colne, for instance, several mills have been bringing their plant up to date ready for the coming spell of unwonted prosperity which everyone now agrees is imminent. Electrical engineers would do well to keep in very close touch with the district during the next few months. Mr. Frank Nasmith, the eminent Textile Consulting Engineer and editor of the "Textile Mercury," is, to judge from his paper read at the Engineering Exhibition, very much impressed with the possibilities of the electrical engineer completely revolutionising the design of textile machinery and so giving the textile industries of this country a new lease of life. Every electrical engineer in a textile centre should consider it a first duty to acquire some knowledge of the many processes involved and of the machinery by which they are accomplished.

The Local Section, I.E.E.

The 1910–11 Session of the Manchester Local Section of the I.E.E. was opened on Friday, the 28th ult., by a smoking concert of the "Midland Hotel." Preceding the smoker, the Chairman for the Session, Mr. J. S. Peck, who presided, read his address. This consisted of an account of the present state of the electrical industry in the United States, as he saw it this summer, and of comments and comparisons with our own. He pointed out that at the present time in U.S.A. the electrical industry is in a most flourishing condition. Reviewing the conditions which exist there, he stated that the demand for labour was usually in excess of the supply, that wages were more than twice the rates usual here, partly as a result of the greater demand and partly because of higher prices all round. The effect of a tariff in the U.S.A. had been to encourage the American manufacturers to push along and develop the enormous home market, with the knowledge that it was reserved for them. The result was that they found themselves so busy that they had little inclination to go in for foreign trade to any great extent. Speaking of the lack of higher technical education among English engineers, he said this was largely due to the fact that the older manufacturers had usually looked with disfavour on the technical student and relied on "practical" experience. In competition with manufacturers of other countries, English firms had now begun to realise that this old idea is a very dangerous one, and that it is the technical men who help on the industries of a nation to the greatest extent. On the motion of Mr. W. Cramp, Vice-Chairman, seconded by Mr. S. J. Watson, the retiring Chairman, a vote of thanks was accorded to Mr. Peck for his address. The smoker was a great success, even for the Manchester Section. Among those who contributed by songs and recitations, grave and gay, to the evening's enjoyment, were Messrs. W. E. Warrilow, T. M. Kirkby, C. E. Crowther, H. Smedley, T. Cocking, E. Warrington, and A. B. Blason. On the conclusion of the programme, Mr. C. D. Taite proposed a vote of thanks to the artistes and to Mr. A. L. Green, the Assistant Secretary, who organised the concert, for their services. The programme before both seniors and students is this year of even more than usual interest and should lead to very full meetings and excellent discussions.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The Highland Railway Company, with its customary enterprise, is building a large hotel at Strathpeffer, the Rossshire spa. The electrical arrangements of this hotel will be of interest to our readers, as they are somewhat

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unusual. As Strathpeffer has a very short season, the new hotel, in common with the other hotels in the village, will be closed for nearly eight months in the year. The expenditure of a comparatively large sum upon generating plant would, therefore, not be justified, and arrangements have been made to take a supply of three-phase current, at 346 volts, 50 periods, from the Dingwall and Strathpeffer Electric Supply Company. The current is supplied at a low figure, and is to be used by the hotel during the hours of daylight only. This daylight supply entails a storage battery system, and a 54-cell Tudor battery of 1,000 ampere hour capacity at the 10 rate is to be used, charged by a motor generator made by the British Electric Plant Company, of Alloa. The pressure in the hotel will be 100 volts, and metal filament lamps will be used throughout, the number of lamps being over 600. An electric passenger elevator will be fitted in the main staircase, and a luggage elevator in a brick shaft, capable of raising 1,000 lbs. at 150 ft. per minute, and 1,300 lbs. at 100 ft. per minute. These elevators are being supplied by Messrs. A. & P. Steven, Glasgow. Special arrangements have been made to prevent the starting of the lifts causing a flickering in the lights, the estimated drop in voltage from this cause being 1%, an amount which will not be visible with metallic filament lamps. Electric case fans for ventilating the coffee room, billiard room, and smoking room, and propellor fans for ventilating the service rooms and kitchen will be supplied by Messrs. Davidson & Company, Ltd., Belfast. The fans ventilating the public rooms will be placed in special fan chambers in the basement, and operated by distant control switches from the public rooms themselves. A large electrical toaster, capable of toasting 30 pieces of bread on both sides at one time, completes the enumeration of the electrical apparatus. The wiring is being done throughout on the concealed system, with heavy gauge enamelled steel screwed tubing, with main and sub-distribution boards on each floor, each section of each floor being controlled from the office on the ground floor. The whole contract, with the exception of the lifts, is in the hands of Messrs. Osborne & Hunter, Glasgow, who work to the specifications of Mr. W. Arthur Ker, Glasgow, the architects being Messrs. Cameron & Burnett, Inverness.

Clyde Valley Electrical Company.

The half-yearly meeting of the shareholders of this company was held at Glasgow on October 21. Mr. A. Bonar Law, M.P., chairman, presiding. The chairman said the progress being made by the company could best be realised by a comparison of the financial results of the years since 1907, when there was a loss of £8,000; in 1908 the loss was reduced to £1,149. In 1909 there was a profit of £10,760, while the profit for the six months ending June of this year amounted to £10,519. The new 5,000 kw. turbo-generating set was now almost completed and would be in operation early next month, bringing the total plant capacity up to 18,000 kw. The company gives a bulk supply to Wishaw, Coatbridge and Airdrie, and its customers now include two tramway companies, shipbuilding yards, iron and steel works, engineering works, brick works, paper works, and upwards of 20 collieries.

Cambuslang Appointment.

Mr. David Eunson has been appointed Chief Engineer to the Cambuslang Electricity Supply undertaking. Mr. Eunson served his time with Messrs. John Dalgleish & Son, Pollokshaws. He next entered the employment of Messrs. Mavor & Coulson, Glasgow, and after being three years with that firm joined the Electricity Department of the Glasgow Corporation 10 years ago. In that service he was gradually promoted until he became senior engineer in charge of the St. Andrews Cross Power Station. Mr. Eunson got his technical education at the Glasgow and West of Scotland Technical College, which he attended for four sessions.

A Novel Use of an Electrically Driven Pump.

The Parks Department of the Glasgow Corporation have just installed an electrically-driven pump of Messrs. Drysdale & Company's make, to draw water from the river Clyde and pump it into an artificial pond in the Richmond Park. The pump is driven by a 6 h.p. motor by the B. T. H. Company; it throws 230 galls. per minute, and has a speed of 1,300 r.p.m. The combined head of water and friction which the pump has got to work against is 34·6 ft. The water is discharged through a 4-inch C. I. pipe into the pond at a distance of 470 ft. In order that the water may be kept from stagnation, the pond will require to be flushed periodically and re-filled by the pump. The combination is working in a most satisfactory manner, and this novel method of filling a pond has attracted many of the inhabitants of the district to witness the pump working.

Glasgow Students' Section of the I.E.E.

Mr. H. A. Mavor, Chairman of this Section, presided at the opening meeting on Friday, October 21, and delivered his inaugural address. Mr. Mavor's address took the form of an informal talk on the best methods to be adopted by young engineers in order to advance in their profession. Incidentally, Mr. Mavor gave the students a good deal of information as to the making up of the selling price of manufactured articles. Mr. R. B. Mitchell, one of the Vice-Presidents of the Section, made a few supplementary remarks. The Section have already secured three papers for subsequent meetings, viz., "Electric Radiators," by Mr. Granville Murray; "Two-speed Alternate Current Motors," by Mr. B. P. Haigh, B.Sc.; and "Sub-Station," by Mr. R. S. Begg.

Odds and Ends.

Greenock Corporation are running a second extra high tension cable to the torpedo factory. This means that the factory is doubling its demand upon the Corporation mains. It is confidently anticipated that the Greenock Corporation undertaking will in the near future obtain powers to supply both Port Glasgow and Gourock.

The United Collieries Company, Ltd., are likely to link up some seven collieries in Lanarkshire, which means that one plant will be utilised to generate the whole of the energy required for haulage, winding, lighting, etc., in the collieries concerned.

The Edinburgh Corporation Electricity Department have just placed an order with the Brush Company for two sets of 1,000 kw. turbo-generators.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

A new linear bolometer has been patented by Herr Leinbach. The conductor, the resistance of which is altered by radiation, is put into one of the branches of a Wheatstone bridge. The resistances of the other three branches of the bridge are adjusted till no current flows through the galvanometer so that the needle is deflected as soon as the resistance of the conductor changes. The most important point is the selection of the conductor. Its resistance must be high and its surface must be considerable, and yet its specific heat must be low. These contradictory requirements have been reconciled to the greatest possible extent by the inventor. For the conductor he uses extremely fine platinum wire (Wollaston wire), flattened out to a ribbon. This ribbon is 0·025 mm. wide and 0·000283 mm. thick, and can be got in lengths of 12 mm., so that the surface exposed to radiation by two ribbons is 0·63 sq. mm. This bolometer is claimed to be much more sensitive than that of Boyes.

German Capital in Norway.

One of the largest factories for obtaining nitrogen from the atmosphere is in Norway, and obtains its power from the Rjukanfos. The Gesellschaft Rjukan Salpeterwerk, in which German capital and German brains are the predominant partners, have taken over these works, and are enlarging them. Nearly all the new electric plant will be supplied by Siemens Schuckertwerke and other German firms. The Badische Anilin und Soda Fabrik is one of the chief shareholders. Ten rows of furnaces, eleven in a row, are to be worked with a 10,000 volt rotary current, and represent an energy of 200,000 h.p.

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Company Affairs.

A new lamp company has been formed in Berlin which will probably do well in spite of or because of its small initial capital of £3,000. It is the Fischer und Berger Wolfram Metallfadenfabrik, G.m.b.H. The somewhat extensive name is self-explanatory, but it may be stated that one of the chief objects of the company is to acquire a secret process for getting tungsten in the form of wire, a process invented by C. H. Fischer, of Berlin, who is to be joint manager with F. Bergner, and to receive 30,000 marks for the process.

The Gas Motoren-Fabrik Deutz A.G., Coln-Deutz, made a net profit of 1,988,570 marks for 1909-10, as against 1,274,401 for 1908-9. The dividend on the capital of 17½ million marks is increased from 5 per cent. to 7½ per cent.

The general meeting of the Aktiengesellschaft Brown, Boveri & Company, of Baden Switzerland, unanimously approved the fusion with the Elektrizitatsunternehmen Alioth and with the Isaria Zahlerwerke of Munich, and also the increase of the capital from 20 to 28 million marks. M. Saras, of Basel, the chairman of the Alioth Company, Dr. Bloch, from the Isaria Works, and Mm. Simonius, Bleumer, and Dubois, of the Schweizerischer Bankverein, together with a Mr. Bolmer, have obtained seats on the board.

The general meeting of the Berliner Elektrizitats Werke, to be held on November 24, 1910, will be asked to approve a dividend of 4½ per cent. on the capital of 20 million marks in preference shares, and one of 11 per cent. on the capital of 44 million marks in ordinary shares. The figures for 1908-9 were 4 per cent. on 12½ million marks of ordinary capital issued in 1908, and 11 per cent. on the old issue of 31½ millions. The company has paid 5,613,316 marks to the City Council. Every prospect is pleasing. Orders are coming in fast, and for the first three months of the current financial year the kilowatt hours (independently of those used by the company for its own purposes) have increased to 40,044,203, which is 5,425,383 more than for the corresponding period in the previous year.

The Thuringische Elektrizitats und Gas Werke A.G., Apolda, is paying a dividend of 8½ per cent. as against 8 per cent. for last year, and business is now better than ever it was.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The great electrical exhibition in Madison Square Garden may be regarded as something in the nature of a landmark in the history of electrical progress and development. From the spectacular point of view the display was magnificent, while the magnitude and variety of the exhibits surprised even those who have, in one way and another, been all their lives associated with the electrical industry. Concrete and striking demonstration was afforded of the fact that there is to-day no department of commercial or domestic life in which electricity has not become a dominant and, indeed, indispensable factor. In the simplest, as well as in the most complex, requirements of modern civilisation it has taken the place preordained for it when Faraday and Henry and Davenport were still seeking light. If its growth has seemed slow, looking back over the two generations which separate to-day from the first definite onward step, it must have been difficult even for the oldest of old-timers who visited Madison Square not to realise that it has at last come into its kingdom, that this is, indeed, the Electrical Age. While, of necessity, the most impressive initial feature of the exhibition was the amazing development of the art of illumination as illustrated by the latest form of metallic filament lamps, the other features of the display were not less striking in the evidence they afforded of the high pitch to which electrical manufactures of many kinds have now been brought. The perfection of finish stands out in admirable contrast with that which satisfied both manufacturers and merchants a few years ago, while the specialisation of electrical engineers upon individual forms of craftsmanship has had a most marked effect upon the development of specific appliances. This was especially notable in the display of motors, of which the types exhibited were a whole generation ahead of those shown at the first New York Exhibition four years ago. All the great electrical houses were represented at Madison Square Garden, and there was not a single exhibit which did not represent the highest and latest forms of electrical evolution. Of the range of purely domestic appliances the exhibits were almost bewildering in their variety and completeness.

The Electric Railway Convention.

While New York was holding its fourth annual electrical exposition, Atlantic City was given over to a great convention of engineers and manufacturers concerned in the electric railway organisations of this continent. The gathering would appear to have been one of the most representative and most successful ever held in the history of the American Street and Interurban Railway Engineers' Association, and the papers read reached a notably high level of scientific and technical importance and interest. The electric railway industry is one which has already attained astonishing dimensions in this country, but it is tolerably clear from the proceedings at Atlantic City that the developments which will be witnessed in the course of the next 10 years will dwarf into comparative insignificance even the wonderful record of progress which has already been achieved. In many of our big cities to-day the steam locomotive is as obsolete as the stage-coach, and the impression left upon the mind by the Atlantic City Convention is that the time is not so very far distant when even the latest type of Baldwin will be by way of becoming as great a curiosity as Stephenson's Rocket. Electrical railway engineers in the Old Country may gather some idea of the interest evoked by the gathering in New Jersey from the fact that the "Electric Railway Journal" published throughout the proceedings a daily edition of which each number aggregated about 100 pages and of which 9,500 copies were printed every day. And this was in addition to a special souvenir number, over an inch thick, which constituted in itself a whole encyclopædia of electric traction. Referring to one of our big electrical gatherings in the spring, an English technical journal—it was not the ELECTRICAL ENGINEER—observed that "these electrical engineers in the United States appear to take themselves very seriously." Well; if the hard-headed business men who run technical journals in this country expend hundreds of thousands of dollars on enterprises of this sort, and find that the equally hard-headed business men who run and supply electric railways support their enterprise to the extent of some hundreds of pages of expensive advertising, it would seem, on the whole, to be rather a good thing that they do take themselves seriously; especially when all concerned find that it pays.

Rail-joints and Welding.

An important subject dealt with by more than one speaker at the Atlantic City Convention was that of rail-joints. The perfect rail-joint (as was pointed out by Mr. Rifenberick, of Cleveland) is at present purely theoretical but progress towards perfection seems to have been retarded only because sufficient attention has not hitherto been given to this particular branch of engineering work. For this reason, if for none other, a certain amount of dissent may be expressed from Mr. Rifenberick's somewhat sweeping conclusion that the perfect rail-joint "will continue to be purely theoretical so long as wheel meets joint in the fight for supremacy." Mr. Lange, at this same meeting, referred to "the only two-welded rail-joints which can be considered absolutely ideal," meaning the Elihu Thomson and the Goldschmidt types, in which the entire surface of the cross-sections of the rail is welded, and even he declared that the difficulties encountered in the practical application of both these types of pure butt welding have proved so serious that neither of them can as yet be considered of practical importance. Mr. Lange's paper, however, was prepared, as will have been already noted, before the later experiments in this type of welding were carried to a successful conclusion. In England and in Germany the process favoured is a combination of cast welding and butt-joint welding which possesses the advantage of requiring not more than an average of 10 to 11 lb. of cast metal on the rail-end—a quantity insufficient to

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disturb the elastic curve of the rail. Another successful system—or one, at any rate, which has given excellent results—is that in which a collar of steel is welded about the web and flange of the rails in such a manner that only about half the rail is united. But in this case climate is an important factor; for obviously with very wide variations of temperature the stress per square inch would outrun the elastic limit of rail steel.

The Perfect Joint.

All this apart, it must be admitted that we are at present a long way from the perfect rail-joint as defined by Mr. Rifenberick in the paper he read before the American Railway Association. The perfect rail-joint, he said, "is a joint of few parts, in which none of the parts could ever be worked loose or worn under the loads applied on the joint. Such a joint should be easily and simply connected to the rail, and as easily disconnected when the rail has worn out. It should be capable of being applied to the second and succeeding new rails, and have such strength that it will hold the rail ends as rigid as the balance of the rail. This joint in elastic track construction must be rigid enough vertically to prevent any deflection of the joint beyond the limit of elasticity of the metal, and in a rigid or non-elastic track construction it must be rigid enough vertically to prevent any deflection, either temporary or permanent. In other words, this rail fastening must hold the rail ends so that there will be no bending upward or downward at the joint. It should require no special form of rail, requiring no increase in the cost of the rail itself." Unfortunately, Mr. Rifenberick offers the engineer little assistance towards the attainment of the ideal thus set forth, though he certainly mentions systems which in his view come nearest to it—namely, the cast-welded, electric welded and the Clark joints. Of these, it would appear that the cast-weld (the Kerwin joint) has achieved the greatest measure of success, mainly, it would seem, owing to the use of a water-jacket to prevent the heating of the heads of the rail. But with due respect to Mr. Rifenberick, it may be pointed out that a far greater measure of success has been attained under the improved Thermit process of the Goldschmidt Company than by any of the other processes mentioned. Under this latest form of Thermit weld, the rail ends are surrounded by a mould fashioned to allow a collar of Thermit steel to be poured round them, and are brought to a red heat by means of a gasoline compressed air torch. The opening is then closed with a dry sand core, and the Thermit charge is ignited in the crucible, and the steel is tapped into the mould in such a manner that it amalgamates with the rail ends to form with them, on cooling, a single homogeneous mass. The superfluous metal is then ground off by emery wheels carried in brackets mounted on a saddle, a device invented by Mr. Pellisier, the Superintendent of the Goldschmidt Company.

A New Induction Motor.

The mechanical superiority and numerous other advantages of the squirrel-cage induction motor have induced Mr. R. E. Hellmund to turn his attention to the designing of a motor of this type which comes within the limits set by the series motor and also compares favourably with it in respect of starting and operating characteristics. This new motor he describes as being somewhat larger than a normal constant speed induction motor, as well as heavier, but at the same time only slightly more expensive than the corresponding direct-current motor, and it is equivalent to a direct-current series motor having a full-load rating equal to that of the induction motor at its highest speed. The terminal e.m.f. of this new motor is 3,000 volts, and the frequency 25 cycles. The weight of active iron core is 5,500 lb., and of the active copper 1,900 lb. The frame is 6 ft. 3 in. in height and the same in diameter, and 3 ft. 4 in. in width. The multi-speed feature is obtained by providing the motor with two two-speed windings in the primary which correspond to 24, 16, 12 and 8 poles, giving as synchronous speeds 125, 187·5, 250 and 375 r.p.m. respectively. The lowest speed is only used for starting. The ventilation of the motor is such that it will dissipate 39,000 watts continuously, and the rating is given at 325 h.p. at 365 r.p.m., the admissable full-load losses being taken at 21,800 watts. Under test it is found that the efficiencies of this motor are considerably higher than would be attained by those of a direct-current machine operating in connection with transforming devices from an alternating current system; while the induction motor has a very important advantage over the series motor in that it can carry at low speeds for an indefinite time torques largely in excess of its full-load torque while the series motor can do so for only a limited period. In the current issue of the New York "Electrical World," Mr. Hellmund gives an exhaustive description of the new motor, accompanied by curves illustrating its operation. In referring editorially to the device, the journal observes that the known characteristics of the polyphase commutator motor are such that it offers highly inviting possibilities for just such purposes as those for which Mr. Hellmund suggests the use of the four-speed induction motor, and forecasts such a development of the alternating current commutator type motor as will enable it to supplant the direct-current motor in installations where all the energy is received over high-tension transmission lines, and where variable-speed, or adjustable speed-work, forms only a small part of the whole service needed.

Improved Electric Heaters.

The Cutler-Hammer Manufacturing Company have signalised their appearance in the field of domestic electrical appliances by the introduction of what is claimed to be an entirely new type of water heater which may be used for baths, tanks, lavatories, and all other ordinary purposes to which electrical heating is applicable. The heating element consists of carbon rods varying in size according to the capacity of the heater. These rods are enclosed in a metal cylinder through which the water flows, and are so arranged that there is an open circuit between them. When the water enters the cylinder, the open circuit between the carbon rods is bridged by the water which forms the connecting link between the carbons and is instantly raised to a high temperature by the passage of the electric current through it. If the current is switched on and the water not admitted, nothing happens at all, since the connecting link is missing, while if the user forgets to turn the current off, no damage accrues, since the water is converted into steam and is ejected from the spout of the heater, and when it has all vanished in the form of vapour, the current immediately ceases to flow. In normal working a period of only 15 seconds elapses between the process of turning on the current and the tap and the emission of a continuous stream of hot water.

The Production of Tungsten Wire.

Dr. Kitsee's process of manufacturing drawn tungsten wire has now passed through its final stages of development, and the result is pronounced by experts to be an unqualified success. It differs from the earlier process in several important particulars. Into a closed crucible into which small quantities of phosphorus are introduced from time to time particles of metallic tungsten are heated until tungsten phosphide is produced. When a number of small ingots of the phosphide have been thus manufactured, they are placed in a larger crucible and fused into a single ignot which is then made the cathode in an electrolytic bath through which current is sent to reconstruct the material into metallic tungsten, which under these processes has acquired a certain amount of porosity. The porous tungsten is then brought to a white heat under the oxy-hydrogen blow-pipe without oxydising the metal, and it is at the same time hammered and rolled. It is then allowed to cool slowly, and is then again heated and hammered into a homogeneous mass. In the final process the tungsten is hammered into the form of a thin rod, and after cooling and re-heating is drawn through dies in the form of thread-like wire which is perfectly ductile. Only two processes of heating and hammering are here described, but it will be understood that if the necessary tenacity is not reached, the process may be gone through a third or even a fourth time though this has not so far been found necessary.

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Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

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Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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EXTENDING SUPPLY.

A novel form of the maximum charge method has been successfully introduced at Eccles, which opens up quite new possibilities in connection with at least two classes of property. At Eccles an experimental block of weekly house property was chosen, the houses being wired at the expense of the landlords (the Corporation) a bulk supply of electricity being given. No meters were used, but a charge of 6d. per week added to the rent. After the first 12 months had elapsed it was found that the amount of current consumed had amounted to 26/- per house a year, charging the units at the usual rate. This left no margin to cover cost of free wiring, upkeep, and cost of collection. So the method explained by Mr. Angus in another column, was adopted. And now the Eccles Town Council are so satisfied with the result that they are willing to extend the system to other blocks of property. It is easy to understand that this system would appeal to a wide class of tenants and property owners, and thus would prove of enormous benefit in staying the downward tendency in the demand for current for lighting purposes as the result of the advent of the metallic filament lamp. By thus tapping large sections of consumers hitherto hardly touched the demand should increase, and, having regard to the character of the property in question, the lighting load should be evened up. This modification of the maximum charge system is equally applicable to cottage property, tenements in blocks of buildings, and moderately rented flats, thus covering wide sections of the population. It has the merits of simplicity and definiteness, qualities which appeal both to consumers and to the supplying authority. In practice it suppresses the use of meters and minimises book-keeping and the expenses of collection; thus notable economies are introduced which should bring about benefits all round. At

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Rotherhithe an experiment has been tried, successfully, we believe, of charging a uniform sum of 2½d. per lamp in summer and 3d. per lamp in winter, for small cottage property. The system of charging, adding a definite amount to the rent for electric lighting, is not, of course, new. It is in active practice in a large number of big blocks of offices, where a stated charge per quarter for each lamp is made by the landlord. In such cases the landlord bases his charges on a fair average consumption of current per lamp during regulation hours, he, however, paying the supplying authority only for the actual amount consumed, as shown by his meter. If the block of offices is a fairly large one, the difference between the estimated and actual consumption is considerable, giving the landlord a handsome additional profit. But the system works well, and gives satisfaction to the tenants. There should be a big future before the Eccles system wherever weekly rented property bulks largely in the local scheme of things.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the apparance of the questions.

QUESTIONS.

Question No. 1229.—It is proposed to warm a small church by electric radiators. The floor area is 70 ft. by 25 ft., height 22 ft. What will be the consumption of electricity and the best type of radiators, and arrangement of same, for the purpose ?

ANSWERS.

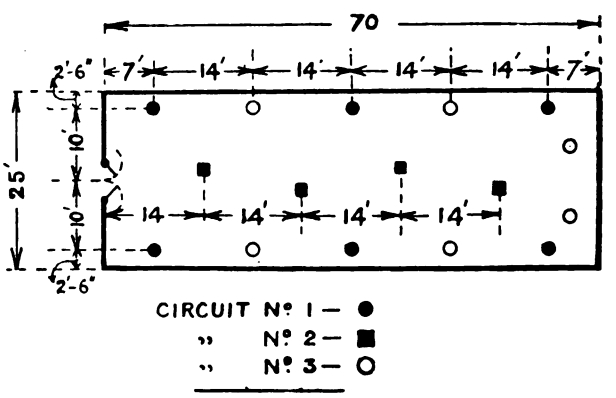
Reply to Question No. 1229 (*awarded* 10s.).—The approximate volume of air to be kept heated in the present case is 70 × 25 × 22 = 38,500 cubic ft., and to maintain this at a suitable temperature (60°F, say), when the external atmosphere is about 32°F, will require an expenditure of electrical energy varying from 0·5 to 0·8 B.T.U. per hour per 1,000 cubic ft. warmed, *i.e.*, a total energy expenditure of 20–30 B.T.U. per hour (costing, at 1d. per kilo-watt hour, 1s. 8d.—2s. 6d. per hour).

For heating such a large volume of air electric *convectors* are much preferable to *radiators*, being cheaper in first cost, more efficient and generally more suited to the service. "Convectors" consist essentially of resistance frames, the strip resisters of which are heated by the passage of current to 260°–300° (or rarely 400°F.): "radiators" are simply large carbon filament glow lamps with specially stout filaments. Convectors warm a building by inducing a rising current of warm air over the resistance strips, whereas radiators warm mainly by radiation, and though more cheerful in appearance than convectors, they heat large volumes less equally and satisfactorily than the latter. For these reasons, rooms of 2,000–3,000 cubic ft., or over, should be fitted with convectors rather than radiators.

Convectors are usually built up of a number of 250 watts strip units, and, by connecting these in series and parallel as may be required, a heater of any desired capacity may be built up. It is conducive to uniform heating and economical results to restrict the consumption per convector to 4,000 or 5,000 watts as a maximum; smaller units, though capitally more costly per kilo-watt, are generally more satisfactory in working.

Assume in this instance the use of 1,500 watt heaters; on the basis of 0·6 kw. hour per 1,000 cubic ft. per hour, each of these will deal continuously with 2,500 cubic ft. of air, hence 15 or 16 such convectors will be needed. By using the larger units fewer separate heaters would be required, but the heating effected would be less uniform and the working less economical, since the three-circuit arrangement of Fig. 1 would no longer be practicable.

It is well to space the convectors about 15 ft. apart along the side walls of the church and about 10 ft. apart perpendicular to these walls; if possible, the heaters should be not less than 2½ ft. from the nearest outside wall. Such an arrangement, employing 16 convectors is shown to scale in the figure. The central row of heaters should be zig-zagged across the nave as shown, and it is useless to place any central heaters too near the main doors. By arranging the convectors on three circuits, somewhat as shown, economical and equable heating can be easily arranged to suit all climatic conditions. It should be noted that many churches are poorly ventilated, and, during hours of service, contain large numbers of people all more or less heavily clad, so that it is neither necessary nor desirable to provide artificial heating on so liberal a basis as would be employed in designing a domestic warming scheme. An allowance of 0·6 B.T.U. per 1,000 cubic ft. per hour should be ample, providing the heaters be switched on some time before the opening of church for service: in some cases, it is more convenient to work from the fact that at least two complete changes of air should be provided (and warmed) per hour. Convectors, warming by convection currents, take some time to heat a space thoroughly, whereas radiators rapidly heat all persons and objects on which their direct radiation falls, but very slowly warm the space as a whole.



The convectors may be mounted on the floor or in chambers or ducts opening up through grids in the latter. Where the heaters are mounted in ducts these should communicate with the external air as directly as possible (by a downward-slanting route), so that the convectors act as heaters and ventilators combined. In such cases the heaters may be designed somewhat more liberally than above, and it would be well to place one or more small exhausting fans near the roof, to remove the heated, foul air. Sunk chambers or ducts avoid any obstruction otherwise caused by the convectors, but they harbour dirt and involve extra capital outlay.

Weight, Size, Cost, etc.—Certain average data, concerning convector units of 1,500, 3,000 and 5,000 cubic ft. heating capacity respectively, are shown in Table I., which requires no comment beyond emphasis of the extreme compactness and lightness of the convectors.

Table I.

Heating capacity (church service)	1,500	3,000	5,000 cub. ft.
Wattage	1,000	1,900	3,000 cub. ft.
Cost per convector (plain)	£3	£4 15	£7
Volume of convector ..	1·6	3·3	4·4 cub. ft.
Weight of convector ..	27½	33	40 lbs.
B.T.U. per hour	1·0	1·9	3·0

Assuming the use of 1,500 watt convectors, 16 of these could probably be procured, in quite a simple pattern, for £50. Subsequent renewals would cost from 1s. to 1s. 6d. per 250 watts heater unit, and the latter usually live at least 5,000 "heating" hours (*i.e.*, 10–12 years, assuming 8 hours use on 50 days per year). (If radiators be used, 250 watt lamps will live 1,000–2,500 "burning" hours,

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and cost 4s. to 4s. 6d. apiece to renew, besides which they are more liable to accidental breakage.) The total installation consumes 24,000 watts, *i.e.*, takes 120 amps. at 200 volts, so that about 500 ft. of cable (which will be required, roughly, by the arrangement of figure will cost, say, £8. Allowing a further £7 for installation and miscellaneous items, the electric convector heating scheme will cost about £65 to install (at a moderate estimate). The attendance and maintenance costs will be low, but the energy cost is high (see also below). Once the congregation is assembled, it is usually possible, and desirable, to cut down the artificial heating to two-thirds or half "full heat."

* *General Advisability of Electric Heating in present case:* 38,500 cubic ft. is rather a large volume to heat electrically, and the alternative hot water, steam or central slow-combustion coal stove systems should at least be carefully examined before embarking on a scheme which is generally considered to be best adapted to the heating of volumes lying between 4,000 and 10,000 cubic ft. Steam or hot water systems would certainly be primarily more expensive than such a convector installation as the above, but the heating would be on a more liberal basis, and the running cost would be much less. (A well-designed and efficiently regulated steam-heating plant would heat a 38,000 cubic ft. building at a total cost of 3s. to 5s. per diem, as against 20s. to 25s. in the case of an electric convector system, under similar circumstances). The cleanliness, flexibility and convenience of the electrical apparatus would, however, be missed.

Suitable gas stoves, of 10,000 cubic ft. heating capacity, would cost about £7 10s. each, and four would here be necessary; the average cost of the various piping required would be about 1s. per foot. The objections to such stoves in comparison with electric heaters need hardly be pointed out.

Slow-combustion coal stoves, though somewhat local in their heating effect (unless used in conjunction with a costly distributing duct system), are surprisingly cheap and efficient, and would probably form the cheapest and simplest means of heating a small church, for, after all, electrical heating must, in such a case, constitute rather a venturesome and luxurious experiment. Perhaps, however, a very cheap supply of energy is available. The compactness and safety, and the uniformity and constancy of the results obtained by electric heating, cannot be denied, but, without wishing to discourage a laudable ambition, it may be pointed out that, *from the merely monetary standpoint*, convectors are usually at least three times as dear (capitally) as an equivalent coal, steam or water heating plant (for buildings of over 10,000 cubic ft. capacity), and the fuel cost is from two to ten times greater in the former case (according to local circumstances).

For a much more detailed investigation of the problems involved above, "H. W." should refer to a series of articles commencing in the "Electrical Magazine," December, 1908, and running through several succeeding issues. —"L. C."

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

Programme of Centre Meetings, Session, 1910-11.

METROPOLITAN CENTRE.—1910.—Nov. 14: "The New Central Power Station," H. C. Gunton; Dec. 12: "Life and Behaviour of Primary Batteries Used for Telephone Purposes," J. G. Lucas.

1911.—Jan. 9: "Testing Paper Core Underground Cables during Construction," L. J. Sell; Feb. 13: "Conveying Systems," E. W. Pettit; March 13: "Principles and Methods of Using Small Power Engines," H. R. Rivers Moore; April 24: General annual meeting.

EASTERN CENTRE.—1910.—Nov. †: Opening addresses, J. F. Lamb; Nov. 29: "Unit Maintenance Cost System," R. J. S. Gold; Dec. †: "Central Battery System of Telephony," T. Cobbe.

1911.—Jan. †: "The Training of a Lineman," E. T. Titterington; Feb. †: "Paper Core Cable Faults, their Localisation and Removal," A. R. Nichols; March †: "A Few Notes on Road-making, Repairs, etc.," A. Evans.

MIDLAND CENTRE.—1910.—Nov. 30: "Unit Maintenance Cost System," R. J. S. Gold; †, "Modern Telephone Systems," J. G. Hill; †, "Internal Wiring and Cabling of Offices," W. E. Twells. A Paper by Mr. Cave Brown Cave has also been promised.

NORTH-EASTERN CENTRE.—1910.—Nov. 28: "Unit Maintenance Cost System," R. J. S. Gold; Dec. 19: *, T. E. Herbert.

1911.—Jan. 16: Annual meeting; Feb. 13: "Office Organisation," G. H. Hoole; March 13: "Maintenance and Duties," J. D. Taylor.

NORTHERN CENTRE.—1910.—Nov. 14: "Some Points in Open Line Construction," T. B. Johnson; Dec. 12: "Aerial Cables," J. McKenzie.

1911.—Jan. 16: "Organisation," J. R. Andrews; Feb. 14: "Telephoning of Small Towns," T. Patterson; March 14: "Notes on Building Construction," H. Kitchen.

NORTH-WESTERN CENTRE.—1910.—Nov. 7: "Wireless Telegraphy," A. C. Timmis; Dec. 5: "Unit Maintenance Cost System," R. J. S. Gold.

1911.—Jan. 9: "Selenium: Photo-Electric Effects and Photo-Telegraphy," W. B. Smith; Feb. 6: "The Maintenance of Trunk Sections in Primary Battery Exchanges," G. Bowyer; March 6: "The Clerical Work of a Sectional Engineer's Office," S. C. Leggett and A. Rowbotham.

NORTH WALES CENTRE.—1910.—Nov. 16: "Section Stocks," T. Adams; Dec. 8: "Unit Maintenance Cost System," R. J. S. Gold.

1911.—Jan. 10: "Underground Construction," J. Crane; Feb. 8: "Methods of Statistics," A. S. Renshaw; March 16: "Contractor's Accounts," T. Plummer; April 12: "Notes on Building Materials," F. Horner. Visits will be arranged to: Seaforth Wireless Station, Lever's (Port Sunlight), Railway Signal Works, Fazackerly.

SOUTH WALES CENTRE.—1910.—Nov. 8: "First-Aid: Its Aims and Objects," Sergeant D. J. Francis (Superintendent of the Police Division of the St. John Ambulance Brigade); Visit to the Engineering Shops of the University College of South Wales and Monmouthshire, conducted by Professor A. C. Elliott; Dec. 13: "Sound, Light, and Heat" (Illustrated by Lantern Slides), J. H. M. Wakefield.

1911.—Jan. 10: "Circulars E. 11 and 12," a discussion to be opened by H. G. Tissington; Feb. 14: "Secondary Cells," C. M. Herbert; March 14: "Short Submarine Cable Across Docks and Rivers" (illustrated by Lantern Slides), H. Cranage; Visit to Ebbw Vale Company's Works.

SOUTH-WESTERN CENTRE.—1910.—Nov. 14: "Unit Maintenance Cost System," R. J. S. Gold. Particulars of other meetings not yet available.

SCOTLAND EAST CENTRE.—1910.—Nov. 9: "Slide Rule," James Patrick; Nov. 30: "Training of Linemen," B. J. Gill; Dec. 14: "General Submarine Work," F. H. Machugh.

1911.—Jan. 11: "Construction of Heavy Main Lines," John Patrick; Feb. 8: *, C. Crompton; March 8: "Notes on Aberdeen Underground," E. Slader; March 29: *, C. J. Mercer; April 19: "Leading-in Arrangements at Edinburgh H.P.O.," J. McIntyre.

IRELAND CENTRE.—1910.—Dec. 7: "Unit Maintenance Cost System," R. J. S. Gold. Particulars of other meetings not yet available.

* Subject to be announced later. † Date not yet fixed.

PRESIDENT'S AWARDS.—Last day for receipt of papers for these competitions is January 31, 1911. The notification of intention to compete must reach the Secretary not later than November 30, 1910.

GREAT EASTERN RAILWAY ELECTRIFICATION.

It appears that extensive alterations are to be carried out immediately by the Great Eastern Railway Company at Enfield Town Station. It is proposed to erect buildings at the western side of the locomotive shed there, which will be used as a generating station. The object is to supply current for the electrification of the line to London in place of present steam traction. Land is about to be acquired to carry out the scheme.

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THE INSTITUTION OF CIVIL ENGINEERS.

The 1910-11 session opened at the above Institution, Storey's-gate, on Tuesday evening last. A very large number of members of both the Institution of Civil Engineers and the Institution of Electrical Engineers were present, amongst the latter being Mr. W. M. Mordey, Mr. R. K. Gray, Mr. Llewelyn Preece, Mr. Leslie Robertson, Mr. Wm. Duddell, Mr. Worthington, Col. R. E. Crompton, Prof. Unwin, Dr. J. Hopkinson, Sir Alex. Kennedy, and Sir John Wolff Barry.

After a fitting expression of sympathy for the death of Mr. Cuthbert Brereton—a member of the Council for the past 10 years—Mr. J. C. Inglis, the retiring President, introduced his successor to the presidential chair, Mr. Alex. Siemens, whom he said was a shining light in the electrical world.

In proposing a vote of thanks to the retiring president, Sir John Wolff Barry pointed out that Mr. J. C. Inglis's name would always be associated with the Institution's new home, as it was during his term of office that the negotiations and arrangements had been completed.

The vote of thanks being seconded and carried unanimously, Mr. Alex. Siemens, the new president, read his presidential address. An abstract of this will be found below :—

Mr. Alexander Siemens remarked that the activity of engineers has been developed in so many directions that the time at our disposal for the discussion of engineering topics has become too short to do justice to all, and this has caused several important branches of our profession to establish societies of their own, where sufficient time can be devoted to their specific subjects. This multiplication of institutions should, however, not be taken as a sign of separation, for papers on every branch of engineering are still welcome in this institution, but as an indication of the important position which the engineer has acquired in modern life.

Having given a most instructive *resumé* of the chief features of the civilization of antiquity, the President said that comparing generally the conditions of life, then and now, we may sum up the difference by claiming that our progress is due principally :

(1) To the improvement of the means of communication ;

(2) To the saving of manual labour by the introduction of mechanical power ;

which main features have caused a general lowering of the cost of " obtainables."

Both these features, characterizing modern civilization, are the outcome of the work of our profession, and we may claim in addition that progress has by no means ceased in our time.

When Hertz discovered the property of electric sparks to start waves of the ether which can be detected at a distance, nobody anticipated that Marconi and others would succeed in developing these small beginnings to the system of wireless telegraphy, of which nowadays so many applications are in constant use.

Again, the polyphase motors and generators of electricity had their beginning in the researches of Professor Ferraris, who demonstrated that three alternate currents can be combined in such a manner that the sum of the three currents at any moment is equal to zero, and that by their aid a revolving magnetic field is produced.

We also know that 25 years ago there were plenty of scientists who doubted whether it would be possible to navigate the air without the aid of balloons or even to fit balloons with sufficient mechanical power to make them travel in any desired direction independently of the wind. We all know that the feat has almost been accomplished, but we do not know how far the art of flying will develop. Perhaps we shall soon be able to disport ourselves in the air in the marvellous way described by Lord Lytton in his book, " The Coming Race."

You will remember that this race was able to perform the most astounding feats by the aid of a store of energy accumulated in a way that is, unfortunately, not clearly described in the book, but I think the younger generation of engineers might try with advantage to utilize the energy contained in radium, of which at present we can only make a very limited use.

If this sounds fantastic, a little reflection will remind you of the fact that for nearly 2,000 years, since Thales of Miletus mentioned it, almost the only electrical phenomenon known to mankind was the fact that amber and some other substances, after being rubbed, would attract light bodies and then repel them.

Even Dr. Gilbert, who was the first to repeat the observations of the ancients and to investigate them in a systematic manner (his book " De Magnete " was published in 1600), would have been incredulous if he had been told that at a future time reversing rolling mills would be set in motion by the agency for which he invented the name of electricity. Why should it not be possible to develop our knowledge of the properties of radium to a proportionate degree and obtain results undreamt of at the present time ? On the other hand, every thunderstorm reminds us that our power over electricity is still very far from complete, and in this way incites us to continue our efforts to increase our domination over the forces of Nature.

When we seek to recognise true progress in the material conditions under which we are living, it is not unreasonable to expect that any further advance will be made on the same lines as differentiate our present civilization from that of the ancients, and that " lowering the cost of obtainables " based upon improvement of communications and upon the saving of manual labour, will furnish a reliable test whether a change suggested to be made in our material surroundings is worth adopting, or is merely an alternative without any prospect of being generally accepted.

The development of the manufacture of glow-lamps is a striking example of the advantage of labour-saving machinery ; at first the lamps were made by a few skilled workers at a high cost, so that they could not be sold for less than 25s. each. This excessive cost naturally restricted their sale, but the efforts of the manufacturers to devise labour-saving machinery were not relaxed until the selling price of glow-lamps had diminished to its present level, when they are sold by the million. Can anybody doubt that the introduction of labour-saving machinery into this industry, far from diminishing opportunities for employment, has not only benefited the skilled workers but has opened new avenues for profitable employment to the so-called unskilled labour.

Nor is the advantage limited to this particular industry ; the possibility of obtaining cheap glow-lamps has increased the sale of dynamos, steam and gas-engines, cables and fittings, giving employment to thousands of workmen. Similar consequences have followed the introduction of labour-saving machinery into other branches of manufacture ; still it appears to be the conviction of the working man that machinery is his enemy.

Coupled with this anomalous attitude regarding machinery is another fallacy which appears to be equally difficult to eradicate, indicated by what is usually called " restriction of output." But this supposed remedy fails because it increases the cost of production. Enhanced cost means diminished demand, and consequently decrease of sale ; but if the sale falls off producers have to be dismissed. The consequence of restriction of output is, therefore, restriction of employment, the very opposite effect of what is intended by its advocates.

Conversely, it may be argued that cheapening the necessaries of life enables the consumer to spend more money on luxuries, if by that expression we designate all that is not absolutely needed to keep body and soul together.

From these considerations it follows that increase of employment can only be effected by the increase of the demand for luxuries, and this can only result from the lowering of the cost of obtainables, indicating by that expression the necessaries of life, as well as its luxuries.

Accepting, therefore, that " lowering of cost " is the most important factor of modern progress, it is as well to emphasize that lower first cost by itself does not prove a " lowering of cost " in the sense that it has been used during the foregoing remarks. The " cost of maintenance " should always be taken into account, in addition to the first cost, when comparing the value of several alternatives presented for the solution of a problem.

Bearing in mind that the distinguishing features of modern civilization, viz., the saving of time, of exertion, and, therefore, of money, are the outcome of engineering science, it will be conceded without further argument that

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"lowering of cost" should be the guiding principle of all engineering design; and by accepting this we admit that successful engineering must be based not only on technical knowledge, but on the understanding of economic laws.

The extent of the influence of commercial considerations has steadily increased since the middle of last century, owing principally to the great improvement in the means of communication, which, as far as technical knowledge is concerned, places engineers of all countries on an equal footing, and permits of unlimited competition between manufacturers wherever their works may be situated.

The importance of this consideration arises partly from international competition, and partly from the tendency to supersede small workshops, as they have existed since mediæval times, by large industrial establishments, because the machinery which is necessary for cheap production involves a capital outlay which can only prove remunerative by manufacturing on a large scale.

With manufactured produce utilised in engineering works, the variety of which is constantly increasing, it is perfectly hopeless to expect that every engineer who requires manufactured goods to carry out his designs can be acquainted with every detail of their manufacture. Moreover, trained technical experts are nowadays entrusted with the task of directing industrial operations in factories, and it is inevitable that they should know more about manufacturing methods and requirements than outsiders.

Complaints have been made lately that some engineers have taken advantage of this circumstance by specifying results only and inviting manufacturers to submit detailed descriptions of the means proposed by them for obtaining the specified results. This procedure implies that six or seven complete specifications have to be worked out by the manufacturers invited to tender instead of only one by the engineer, and, it is complained, this enables a person who is not competent to draw up a satisfactory specification by himself to act as superintendent of works to the exclusion of really competent engineers. In fact, it is alleged that sometimes the first proposals are not accepted, but their details are utilised by the engineer for drawing up a complete specification of his own.

The objection to this way of specifying engineering works apart from its moral iniquity, is the waste of time it involves' and it is no excuse to say that the client will in the end' obtain better work than, *ex hypothesi*, his engineer could have devised by himself.

The question is, who is to determine the construction or specify the tests under such circumstances: the engineer who wants the apparatus for one particular purpose, or the manufacturer whose inclination is to consider nothing but cheapness of construction?

Fortunately, our institution has furnished a satisfactory solution of the problem by establishing, in conjunction with other kindred institutions, the Engineering Standards Committee. By referring to the publications of this committee, the consulting engineer can rely upon obtaining apparatus that will pass the tests therein specified, and the manufacturer can adapt his processes to the requirements set out by the committee without the risk of being invited to quote to specifications which may upset his methods of manufacture without benefit to anybody.

There are, however, two features of its activity which the committee will have to keep steadily in view: the one is the ever-increasing variety of manufactured produce requiring standard specifications, and the other the need of constant revision so as to avoid hampering progress. This task is made more difficult by the international character of the competition in manufactured articles, which accentuates the necessity not only of doing all that is possible to increase economy of production, but also to facilitate in every way the introduction of new industries.

The same reasons that have led to the establishment of the Engineering Standards Committee in this country hold good for international dealings, so that we may look forward to the time when international standard specifications will be accepted all over the world. A beginning was made when the British Association introduced in 1861 the C.G.S. system of electrical units, which, since that time, have been adopted internationally, and a further step has been taken at the St. Louis Exhibition of 1904, when the International Electro-Technical Commission was called into being.

It is a very significant circumstance that it has been found necessary for this Commission to associate itself in some branches of its activity with the Engineering Standards Committee, and it is not unreasonable to expect that such joint international action will gradually extend beyond the field of electricity.

Even the bugbear of the metric system of weights and measures loses some of its terrors when you come seriously to grapple with the problem of converting the values determined by the Engineering Standards Committee into metrical measure.

In all cases where extreme accuracy is required, so that limit gauges or interchangeable leading screws are employed, it is evidently of no great moment whether the dimensions have been stated in English or in metrical measure; but there are a great many specifications issued by the Engineering Standards Committee in which a latitude of from 2 to 5% in the dimensions and in the weights are permitted. Considering an English pound avoirdupois plus 10% equal to half a kilogramme and 40 inches equal to one metre keeps the error within these limits, so that anybody can convert those tables of the Engineering Standards Committee into metrical measure without much trouble.

That the metrical system will eventually be adopted is foreshadowed by the House of Commons Committee of 1862.

About that time a commission was appointed in Germany for the express purpose of devising a national system of weights and measures, but after carefully investigating the subject, it decided not to elaborate a national system, but to recommend the adoption of the metrical system.

In both cases the desire to facilitate communication between the various nations decided the committees, after carefully listening to the arguments of a number of witnesses, to favour an international system rather than a national one, and since that time no new arguments have shaken these conclusions.

If the improvement in communications has thus the tendency of aggravating the burden of competition and of placing all nations on a footing of equality, it ensures, on the other hand, the continued progress of our civilization by guarding it from the fate that the culture of so many ancient empires has experienced, which have left only scanty traces of their once flourishing state, because no adequate means existed for spreading their knowledge or for protecting it from destruction.

There is the further advantage that in conjunction with the saving of manual labour, modern facilities of communication ensure leisure, and thereby opportunity for cultivating the mind in other respects than merely on utilitarian lines.

We engineers may claim, therefore, that our endeavours have materially furthered the great modern object of conferring the greatest good on the greatest number, but in continuing our efforts we must never forget that in these strenuous times more than ever the admonition of the Preacher obtains: "Whatsoever thy hand findeth to do, do it with thy might."

Sir Alexander Binnie proposed a vote of thanks to Mr. Siemens, and remarked that the address had in no sense been a narrow one. He thought it probable that in the future when the address was reviewed it would be found to contain some seeds of great importance, greater, probably than could be seen at the present time.

Sir Alex. Kennedy seconded the motion, which was carried with acclamation.

The medals and awards for the past session were then presented to the successful authors, after which the meeting terminated.

At the second ordinary meeting, which is to be held on November 8, a paper entitled "The London County Council Holborn to Strand Improvement and Tramway Subway," by G. Wm. Humphreys, will be read.

CORRECTION.

In our notice of the British Thomson-Houston Company's M.H. Ampere-Hour Meter last week an error occurred. This meter is, of course, calibrated to read in Board of Trade units.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ACTON.—A ratepayers' meeting has been held to protest against the proposed handing over of the electricity undertaking to the Metropolitan Electric Supply Company., Ltd., for a term of 42 years. The Local Government Board and the Board of Trade are to be memorialised, and opposition will probably be offered in the Committee stage of the Parliamentary proceedings.

BRIDLINGTON.—The Town Council propose opening showrooms in connection with their electricity undertaking.

GILLINGHAM.—The Local Government Board held an inquiry into an application for powers to borrow £3,500 for extension of the electricity undertaking.

GREENOCK.—Extensions of the electricity works and plant, involving an expenditure of between £15,000 and £16,000, are proposed.

HITCHIN.—The Town Council's attention was called to the fact that a charge was being made for the lighting of the town hall of 5d. per unit. The actual agreement was that the maximum rate for offices and public buildings should be 4½d., for outside 6d. and for street lighting 3d. per unit. The clerk was instructed to investigate the account.

HULL.—The Hessle Urban Council are entering into negotiations with the Hull Electricity Committee as regards the Hessle Electric Lighting Order, which is at present in abeyance.

KINGSTON-ON-THAMES.—Mr. J. E. Edgcome, in his report on the past year's trading of the municipal electricity works, points out that the outstanding features are the increased use of electricity for driving fans, for heating and cooking, and the great demand upon the system of deferred payment for wiring. The revenue, at £10,906, showed a falling off of £80, while there was an increase in expenditure of £312. The debit balance was £1,644, while for the previous year it was £1,251. Mr. Edgcome, however, feels confident that an improvement is now taking place.

KING'S LYNN.—Mr. J. Pilling's report on the Borough Electricity Undertaking for the past year is very favourable. On a revenue of £7,651 there was a gross profit of £3,975, of which a little over £3,100 was required for debt service, £200 was written off on meters account, and £1,081 carried forward. The chief items of income were £4,501 for sale of current from meter, £47 for sale of current under contract, £1,628 for public lighting, and £1,219 for sale and repair of lamps.

LEEDS.—The Head Post Office is to be greatly enlarged.

LEEK.—The Urban Council made an application to the Electricity Committee of the Potteries Council for the loan of Mr. Yeaman's services, to advise them on the local electricity undertaking. Mr. Yeaman was willing to act, and stated that he would hand over the fee to his Corporation, but owing to the heavy amount of work at the Potteries, the request has been reluctantly refused.

LEYTON.—The accounts for the Council's electricity undertaking for the past year have been issued. The total working expenses were £18,284, and the income £32,453, this including £13,363 for sale of current for private lighting and power, £8,462 for public lighting, and £10,207 for tramways. After providing for capital account charges, the net profit was £2,117. This shows a fairly progressive state of affairs.

LIMERICK.—Mr. Aubrey V. Clayton, M.I.E.E., of New Broad-street, London, E.C., has presented a lengthy report to the Town Council on their electricity works. He advises very drastic measures to bring the works into proper working order, and advocates the laying down of storage batteries as a precautionary measure and a means of equalising the load.

LONDON: ISLINGTON.—The Lighting Committee have decided to instal 16 arc flame lamps in Brewery-road, Cross-street, North-road, and Market-road, at a cost of £660. These lamps will displace 40 gas lamps, and the estimated saving will be £61 per annum.

NEWARK.—Mr. C. Pullen is endeavouring to form a local company in order to start electricity works in the town, and has approached the Town Council on the matter. Mr. Pullen's communication has been referred to a committee.

PORTRUSH.—The Urban Council have decided to apply for a Provisional Order under the Electric Lighting Acts. A firm is prepared to put up the installation for about £557.

STOKE-ON-TRENT.—It has been decided that another feeder be laid from the Burslem works to Newport-lane in order to provide a duplicate supply for large power users, to prevent overloading on the existing feeder, and to enable the Wolstanton feeder to be re-connected, at an estimated cost of £1,000.

SWANSEA.—The Public Accountants, in their annual report of the finances of the city, state that the net profit on the electricity undertaking was £5,260. They hold that this sum should be kept in hand to meet any extraordinary expenditure.

TONYPANDY.—The Mid-Rhondda Chamber of Trade has petitioned the District Council to provide the district with electric light and power.

WILLESDEN.—The annual accounts of the Urban District Electricity Undertaking for the year ending March 31, shows that the expenditure was £17,335, including £12,664 for purchase of electricity in bulk. The revenue amounted to £27,434, including £23,286 received from private consumers and £2,992 for public lighting. After paying for loan charges the net profit was £1,600.

OVERSEAS.

BERLIN, ONTARIO.—The Hon. Adam Beck, Minister of Power, inaugurated the hydro-electric power system here. The power is derived from the Niagara Falls.

JAMALPUR.—The East Indian Railway Locomotive Workshops have been fitted up with an electric welding installation.

WELLINGTON, NEW ZEALAND.—The City Corporation considered tenders for two economisers yesterday, and will open tenders for steam piping on the 17th inst.

TRACTION.

HOME.

BOURNEMOUTH.—At a meeting of the Town Council, reports were presented with regard to substituting an overhead system for the existing conduit system used for the tramways through the centre of the town. Councillor Bell, chairman of the tramways committee, stated that by such a change they would save £3,000 yearly. Almost complete unanimity was manifested towards the proposed change, and on a vote being taken in favour of the overhead system being installed only one councillor voted against the scheme.

BRIGHTON.—An effort is being made to secure a further reduction in the price of current supplied by the Electricity Committee to the Tramways Committee. The charge was recently reduced from 1·35d. to 1·2d. per unit.

BURNLEY.—Major Druitt has held an inquiry on behalf of the Board of Trade into the proposal to increase the maximum speed of trams from 12 to 14 miles per hour. The increases over various sections will be from 8 to 10, from 10 to 12, and from 12 to 16. The Inspector will report to the Board.

GLASGOW.—A ratepayers meeting has adopted a resolution to the effect that the Corporation tramways surplus ought not to be paid in aid of rates, but should be expended in cheapening fares and improving service.

SCARBOROUGH.—The Scarborough Tramway Company, having paid no dividends since its initiation, and having borrowed money to its fullest powers, proposed to stop service during the winter, which was estimated to save £700. The Corporation objected to this proceeding and a Board of Trade Inquiry has been held. The company say that if they are not allowed to discontinue service during winter, they will have to close down altogether.

STOKE-ON-TRENT.—The Corporation are bringing pressure to bear on the Potteries Electric Traction Company, Ltd., to secure better service and an abatement of the excessive noise caused by the cars.

TORQUAY.—The Board of Trade have renewed the tramway company's licence.

OVERSEAS.

MONTREAL.—Sir Thomas Shaughnessy states that there was no immediate prospects of the electrification of the mountain sections of the Canadian Pacific Railway.

OTTAWA.—Application will be made to the Parliament of Canada at its next Session for an Act incorporating a company, under the name of the Niagara, Welland and Lake Erie Railway Company, with power to construct and work a line of railway from the City of Niagara Falls, New York State, to points on Lake Erie between Fort Erie and Port Dover, to generate electrical energy, etc.

COMPANIES' MEETINGS AND REPORTS.

WESTERN TELEGRAPH.

After transferring £135,000 to the general reserve fund and £10,000 to the land and buildings depreciation fund, a final dividend of 3s. per share, making a total of 6% for the year ended June 30, is declared, and also the payment of a bonus of 2s. per share, both free of tax. The balance of the account is carried forward.

CORDOBA LIGHT POWER AND TRACTION.

The report for the year ended September 30 last states that the balance of profit to that date, after meeting all

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charges, is £17,507, to which must be added £4,867 brought forward, making a total of £22,375. The directors recommend a dividend at the rate of 3% (less income-tax) on the shares of the company, and that £8,202 be carried forward.

MELBOURNE TRAMS AND OMNIBUS.

The report states that the balance for the year to June 30, after paying the usual dividends, making the necessary reserves and including £30,502 brought forward, less £4,328 paid as bonus to employees, is £59,652. From this the directors propose to pay a dividend bonus of 6d. per share, £24,000, and a bonus to employees for this year, £8,847, leaving to carry forward, £26,804. The traffic receipts have improved by £16,606 and 2,111,454 more passengers have been carried than during the previous year.

METALITE, LTD.

The statutory meeting of Metalite, Ltd., was held at the Institute of Chartered Accountants, Moorgate-place, E.C. Sir Thomas Brooke-Hitching presiding. He said: The prospectus, dated July 21, 1910, stated that the minimum subscription upon which the company would go to allotment was 150,000 £1 shares, and you will see from the report before you that that number of shares has been duly applied for, and that 10s. per share has been paid thereon. Your company has now actively taken over the British Metalite Lamp and Metal Filament manufacturing business, goodwill, and assets in the United Kingdom of the Bryant Trading Syndicate, Ltd., and the business, patents, processes, and good will of International Filaments, Ltd. I am glad to say that the prospects are of the brightest, although, at the same time, the present position is somewhat irritating. The factory in Horsell-road, Highbury, is working at full pressure, and every available inch of space has been utilised. But, as you are all no doubt aware, the present factory accommodation is totally inadequate, not only to cope with new business, but to deal with the contracts already in hand. Since the beginning of August alone the company has been regretfully compelled to refuse for delivery during the present season orders approximating to 980,000 lamps. On the one hand, it is disappointing to see profitable business pass us, but it is satisfactory to know that when our extension is completed the business is there waiting for us. On the matter of this extension it will interest you to learn that there has been keen competition between various municipal corporations for the purpose of inducing us to build a factory in their respective districts. This is only natural, as our business holds out every promise of attaining to phenomenal proportions, and, as such, it means an important development to the town of our choice. Your directors have gone carefully to work in this choice, and have personally visited the various districts to inquire into certain conditions which are essential to the successful manufacturing of our lamps. The Midlands was found to be the most suitable, and we were fortunate in finding there a freehold factory already built, which can be readily adapted to our purpose. Mr. Metcalfe, the managing director, is conversant with every detail relating to the business of Metalite, Ltd., and I will now call upon him to amplify my remarks.

Mr. Joseph Metcalfe (the managing director) said: As less than three months have elapsed since the formation of Metalite, Ltd., that has not been much time for progress in our development scheme, and we have been further hampered by the intervention of the holiday season. It affords me much pleasure, however, to be able to inform you that we have now purchased a factory in the Midlands and the freehold land on which it is built, as well as some freehold land adjoining. The acquisition of this factory is what I might term a piece of good luck. It was built only two years ago, and a few unimportant alterations are all that are necessary to adapt it to our requirements. It cost approximately £14,000, and we have bought it, along with a piece of adjoining freehold land, for exactly one-half of that amount—£7,000. We are also negotiating for the purchase of additional freehold land which adjoins, so that we should be in a position for still further development. The factory as it now stands has a floor space of about 40,000 sq. ft., the adjoining land which we have already bought will give us, when built upon, an additional floor space of about 60,000 sq. ft., and the land for which we are now negotiating will give us, when built upon, a further floor space of about 100,000 sq. ft., making in all a total of nearly 200,000 sq. ft. The site is in every way suitable for our requirements. To begin with, it is admirably suited for transit purposes. Then there is a plentiful supply of the particular kind of labour which we require. Arrangements have been made for the supply of electricity and gas, of which we are large users, at an extremely low rate, and we expect to effect a saving of some thousands of pounds per annum on these items alone, not only as compared with the rates which we are at present paying, but also with prices upon which your directors and the engineer based the estimate of revenue and profits in the prospectus upon which you became shareholders in this company. Your chairman has already touched upon the eagerness displayed by various corporations to induce us to establish our new factory in their own particular district, and exceptional facilities have been offered to us with this end in view. The reason is a very obvious one. The manufacture of metal filaments and metal filament lamps is a new industry for this country, and its potentialities are so vast that the establishment of our factories in particular districts must inevitably add considerably to the prosperity of that locality. But I will not take up your time by elaborating further upon this detail, except to say that we have been most courteously treated by the mayors and corporation officials of the various districts which we have inspected.

What will interest you more closely is an account of the prospects which we have in front of us. Your chairman has already informed you that they are of the brightest; but I question if any one of our shareholders has yet realised to what an extent this is really the case. To begin with, I will deal with the orders which we now have in hand, and upon which we are at present working. An analysis of these shows that when they are completed they will produce a net profit exceeding £160,000. Of course, this includes several contracts which are spread over a term of five years. But the orders which we have accepted are but a small proportion of what we could have secured if we had been in a position to deal with them. In this country alone we have regretfully been compelled to decline, since the beginning of August, orders for about 980,000 lamps, because we could not guarantee delivery during the present season, and the offer of these orders came to us without any special effort on our part. Some of the largest contractors and factors have informed us that they will be only too pleased to stock and push our lamps if we can guarantee delivery, and in the case of some of these firms their requirements aggregate from 100,000 to 400,000 lamps in the year. A number of firms, too, have notified us to the effect that when we are in a position to supply them with their requirements they will confine themselves to the sale of British "Metalite" lamps, to the exclusion of all other makes of metal filament lamps. These facts must be to you, as they are to us, a source of keen gratification. They prove that the public are being educated up to the fact that the British-made "Metalite" lamp surpasses its rivals, and to maintain this superiority is one of the fundamental principles in the policy of your board. There will also be a considerable revenue derived from the granting of licences in foreign countries to manufacture under our patents, and negotiations are already proceeding in this respect with the Continent, America, and Australia. But to return to our home production. Numerous letters have reached us complaining that the writers have been unable to obtain a supply of our lamps. We are only too conscious of the fact; but our supply is limited to our present capacity for manufacturing. Before many months have passed we hope that all grounds for complaint in this respect will have been removed, and when this object has been achieved we shall all have every reason to be proud of what must ultimately prove to be a great British industry.

Mr. Ormerod inquired whether the directors were sanguine now that the brilliant prospects held out in the prospectus would be realised. They knew there was a good deal of competition and difficulties in connection with an undertaking of this character.

The Chairman, in reply, said that the directors saw no reason to doubt any of the statements in the prospectus. Everybody was now asking for their filament lamps.

A vote of thanks to the Chairman terminated the proceedings.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 139, Fleet Street, London, E.C.

CONTRACTS.

BOROUGH OF BOOTLE.

TO ELECTRIC LIGHT CONTRACTORS.

The Corporation of Bootle invite TENDERS for Supplying and Fixing a complete ELECTRIC LIGHT INSTALLATION at the new Balliol Council Schools, now in course of erection in Bootle. Specifications and Tender Forms can be obtained from the Borough Electrical Engineer's Office, Electric Light Station, Pine-grove, Bootle, where plans of the Schools can be inspected.

Sealed Tenders, endorsed, "Balliol Council Schools Lighting," are to be delivered to the Borough Electrical Engineer, at the above address, not later than 12 o'clock noon on Thursday, November 17, 1910.

The Corporation do not bind themselves to accept the lowest or any Tender, or to defray any expenses incurred by the persons tendering.

By order,
J. HENRY FARMER, Town Clerk.

October 31, 1910.

PORT OF LONDON AUTHORITY.

CONTRACTS FOR MATERIALS AND STORES.

The PORT OF LONDON AUTHORITY invite TENDERS for supplies of Materials and Stores during the twelve months ending December 31, 1911, including :—

Ropes, Lines, etc.
Twines, Cords, etc.
Bagging, Canvas, Gunny and Hessian Cloths, etc.
Wrought Iron and Mild Steel.
Rivets, Bolts, Nuts, etc.
Nails, Spikes, etc.
Ironmongery, etc.
Crane Chain.
Gas, Steam, Water and Hydraulic Tubes and Fittings.
Tinware, etc.
Brooms, Brushes, etc.
Baskets.
Casks and Cases (Wine and Spirit).
Do. (Dry), Staves and Headings.
Hoops (Wood) and Hurdles.
Packing Cases (Wood).
Corks, Bungs, Shives, Faucits, etc.
Metals and Metal Sundries.
Gun Metal and Iron Castings.
Bricks, Slates, Drain Pipes, Ballast, etc.
Paints and Varnishes.
Oils.
Drysaltery, etc.
Portland Cement.
Carbons for Electric Lights.
Electric (Incandescent) Lamps.
Glass and Glassware.
Broken Granite.
Timber.
Railway Sleepers, Crossing Timbers, etc.
Cotton Waste, etc.
Asbestos, Packings and India-rubber.
Straw.
Sawdust.

To be delivered as required at any of the Authority's depots :—
(a) In London (including Royal Victoria and Albert Docks E., and Strand-on-the-Green, Chiswick, W.)
(b) At Tilbury Dock.

Specifications and forms of tender may be obtained on application to the Manager of the Stores Department, 106, Fenchurch-street, E.C., on and after Wednesday, November 9, 1910, between the hours of 10 a.m. and 4 p.m.

Tenders must be enclosed in the official envelopes provided for the purpose and posted so as to reach this office not later than 10 a.m. on Saturday, November 19th, 1910. Any tender received later than the time specified or sent otherwise than by post will not be considered.

The Authority do not bind themselves to accept the lowest or any tender.

ROBERT PHILIPSON,
General Manager and Secretary.

Port of London Authority,
109, Leadenhall-street, London, E.C.
November 1, 1910.

OSRAM LAMPS

BISPHAM-WITH-NORBRECK URBAN DISTRICT COUNCIL.

ELECTRIC LIGHTING.

The Bispham-with-Norbreck Urban District Council invite Tenders for the Supply and Erection of the following Plant, required for their proposed Electrical Generating Station, and are prepared to accept Tenders, subject to the Local Government Board's sanction being obtained to the necessary Loan :—

Section A.—Gas Engines, Gas-producing Plant and Dynamos ;

Section B.—Switchboard, Balancers and Boosters ;

Section C.—Storage Battery ;

Section D.—Mains (Overhead and Underground).

Copies of the Specifications (the Sections A, B, C and D are bound together), General Conditions, Forms of Tender, etc., may be obtained from the undersigned only, on and after Monday, the 7th inst., on receipt of a Deposit of Two Guineas, which will be returned when a *bona-fide* Tender has been received.

Plans of the proposed works may be seen and copies taken during the usual office hours, at the office of Mr. J. W. Speight, M.I.E.E., A.M.I.Mech.E., The Elms, St. Anne's-on-the-Sea, or at the office of the undersigned.

Tenders, sealed and endorsed "Electric Lighting, Section —," are to be delivered to the undersigned on or before 12 o'clock noon on MONDAY, NOVEMBER 21, 1910.

The Council do not bind themselves to accept the lowest or any Tender.

J. W. TICKLE,
Clerk to the Council.

Clerk's Office, Council Offices,
Bispham, Blackpool, November 1, 1910.

CONTRACTS OPEN.

HOME.

BOOTLE.—The Corporation invite tenders for the electric light installation at the new Balliol Council Schools, Bootle. Particulars from the Borough Engineer. November 17.

BRADFORD.—Corporation Tramways.—Miscellaneous stores. (Specification, £1 1s.), from the Manager. November 12.

BUCKINGHAM.—The Guardians of the Union invite tenders for (a) complete installation for the generating and storage of electric current ; (b) complete system of wiring suitable for a voltage of 100 with 70 lights ; (c) complete system of wiring suitable for a voltage of 220 with 70 lights. Particulars from the Clerk to the Guardians, 26, West-street, Buckingham. November 4.

COLWYN BAY.—Urban District Council.—Switch panel, including switches and instruments. (Specifications, 10s. 6d., Electrical Engineer, at works). November 12.

DUBLIN.—The United Tramways Company, Ltd., invite tenders for the supply of general stores, including car fittings, iron, steel, castings, oils, paints, glass, brushes, ironmongery, harness materials, electric supplies, timber, etc., for the year ending December 31, 1911. Forms (2s.) from the Secretary, 9, Upper Sackville-street, Dublin. November 7.

LONDON.—The Port of London Authority invite tenders for the supply of materials and stores for twelve months ending December 31, 1911. Specifications from the Manager of the Stores Department, 106, Fenchurch-street, E.C. November 19.

LONDON.—The London County Council invite tenders for the supply of ash dust removing plant, by means of suction fans, for the electricity generating station, East Greenwich. Particulars (40s.) from the Clerk to the Council, Spring-gardens, S.W. December 6.

WARRINGTON.—Borough Council.—Annual supply of motors and transformers. (Particulars from the Electrical Engineer). November 15.

WELLINGTON.—Corporation.—Steam piping for electric lighting department. (Particulars from J. H. Woodward, 8, Queen Anne's-gate, S.W.) November 17.

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OVERSEAS.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham House Old Broad-street, E.C., and Central House, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a bona fide tender.

TENDERS ACCEPTED.

HOME.

LONDON.—The London County Council have accepted the tender of F. Troy & Company, 194, Finchley-road, for the installation of electric lighting at the Hoxton House Schools, Hoxton, for £615, and E. Newbald & Company, Court-road, Sutton, for the installation of electric lighting at the Sherington-road School, Greenwich, for £256.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

BELFAST: City Surveyor. Baths at Legoniel.

DUBLIN: Office of Public Works. Police barracks and station at Fitzgibbon-street.

DUTTON: P. Silcock, architect, Egypt-street, Warrington. Scarlet fever block, for 12 twelve beds, at the Infectious Diseases Hospital.

OSWESTRY: Appleyard & Juiggin, architects, 67, Lord-street, Liverpool. Secondary school for 140 pupils.

STOCKPORT: Secretary, Stockport Industrial and Equitable Co-operative Society, Ltd., Chestergate. Fittings for new branch.

WEST STANLEY (Durham): T. E. Taylor, architect, Lancaster. Club and Institute.

NOTES.

Theatre Lighting.

We understand that the Palladium Theatre of Varieties, which is the largest building of its kind in London, will also be second to none in regard to the lavishness of its illumination and the handsome designs of the hand-made electric fittings. Whilst certain minor details of the lighting are still undecided, it can be stated that the fittings in the auditorium will be chiefly of the Georgian type in a dull brass finish. The main ceiling will have two 50-light electroliers, eight 10-light electroliers, and other fittings; corresponding designs of brackets, 3-light pendants and ceiling fittings will be employed for the fronts, ceilings and walls of the various circles. The stalls, saloon, lounge and landings will be lighted by electroliers and other fittings of specially heavy Georgian design, whilst fittings of Louis XV. style, in gilt and crystal, have been selected for the dress circle saloon. The floats, battens, hanging lengths, proscenium lights, bunches, etc., are all of the most modern types, and efficient provision has been made for the lighting of the passages, dressing rooms and other similar situations. The fittings for the interior allow for an aggregate of approximately 1,200 lights, whilst a large number of special signs and arc lamp brackets will be mounted on the exterior. "Tantalum" and "Onewatt" lamps and Siemens arc lamps will be employed exclusively for the lighting, and the whole of the fittings are being supplied by Messrs. Siemens Brothers Dynamo Works, Ltd. (Fittings Department, Tyssen-street, Dalston), whose own artist is responsible for the accepted designs.

Westinghouse Drum Type Controllers.

The British Westinghouse Electric and Manufacturing Company, Ltd., have just issued a new 24-page catalogue (60/1A) on Reversing Drum Type Controllers for operating series shunt and combined wound motors, cranes, hoists, winches, machine tools, textile and printing machinery, general industrial work, etc. These controllers, which are all of the single handle type, are built on the metal and mica principle, as required and supplied to the Admiralty. A distinctive feature in their construction is that each part is standardised as a detachable unit in itself, so that replacements and repairs may be easily and rapidly effected from stock parts. The construction is simple and strong, and the parts so arranged that the controller is easily opened up for inspection and cleaning, while the best material and workmanship is employed throughout. The metal and mica principle embodied in the construction of our control apparatus ensures satisfactory operation under the most trying conditions. Drum rings, finger bases and switch parts are clamped on to mica insulated steel bars, producing a most rigid and at the same time fireproof construction. The mica makes an ideal insulation, as it withstands any climatic conditions without deterioration, and always gives a high insulation resistance. The British Admiralty insist on this construction for their dockyard and shipboard use, and a large number of controllers, etc., built on this principle have been supplied to them by the Westinghouse Company.

Osram Advertising.

The General Electric Company, Ltd., in pursuance of their advertising campaign, have issued a new folder, No. S1343, and also a striking "First Class" Novelty Card, both of which are their latest Osram advertisement productions. These are at present being circulated amongst the trade, with an offer to supply them in quantities, overprinted with contractor's name and address thereon, for distribution amongst their customers. Another attractive

novelty takes the form of Osram advertisement shades, which are now being distributed amongst contractors throughout the country for display in their window or showrooms. As a glance at our illustration will show, these shades can be readily attached to existing lampholders, and effectively take the place of any existing opal or other shade, at the same time making a very handsome, striking and useful advertisement.

New London Office.

For the purpose of getting into closer touch with their engineering friends in the south of England, Messrs Hans Renold, Ltd., have opened an office in Kingsway-house, Kingsway, London, W.C. It will be managed by Mr. Charles E. Holliday, M.I.M.E., who has held a leading position with the firm in Manchester for many years. They propose that at present the London office shall deal particularly with matters requiring personal attention, but that ordinary enquiries and correspondence shall be addressed to Manchester as hitherto.

A. E. G. Electric Company in Birmingham.

The A. E. G. Electric Company, Ltd., have opened branch offices at Winchester-house, Victoria-square, Birmingham. Their local telephone number is 7564 Central, and telegraphic address: "Circuit, Birmingham."

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TASMANIAN WATER POWER.

Possibilities of Tasmanian Lakes.

Mr. F. A. M'Carty, an electrical engineer widely known in Australia, and Consulting Engineer to the Complex Ores Company, has, we are informed from official sources, been in Hobart during the last 10 days, and during that time he made a close examination of the Great Lake and the site upon which it is proposed to build the company's generating station. "After a careful examination of the Great Lake scheme, I am convinced that it presents wonderful possibilities.

"I visited the lake last Tuesday, being accompanied by Mr. Butler, the Tasmanian surveyor for the company, and I inspected the proposed site of the dam or weir, and found it to be a most suitable place for erecting a weir. It can eventually, if the company thinks fit, be raised, approximately, to a height of 16 ft., although I understand the company only contemplates erecting a dam 4 ft. high at the start. The area of the lake is, approximately, 26,000 acres, and from a rough calculation which I made on the spot, I found that a 6-inch rise on the lake, without counting on any supply coming in or making allowance for any evaporation, would run a plant generating 24,784 h.p. for 31 consecutive days. On this basis, with a dam 4 ft. high, built as the company proposes, enough water could be conserved to run the plant for eight months without any additional supply. For example, suppose there was an eight months' drought—an unprecedented thing in the lake district—enough water could be stored with that 4 ft. dam to run that huge plant for the period I mention. The evaporation and other losses which would take place would be compensated for by the ordinary supply coming in during this time. In connection with this point, I can quote even stronger figures. Twenty-five thousand horse-power is one-half of the original installation at Niagara. If the dam were raised to 8 ft., we could generate, without any further expense, 50,000 h.p., which would be equal to the power of the first plant put in at Niagara. This will show what possibilities there are in front of this scheme. As a matter of fact, the possibilities are illimitable, for with the diversion of the upper waters of the Ouse into the lake I calculate 100,000 h.p. could be generated without trouble. All these remarks are subject to the point which I touched on a little while ago, and that is, with suitable damming enough water can be stored at the lake to last out an eight months' drought, and so that ought to allay any doubts which people might have as to the chances of getting a continuous supply.

"People can hardly appreciate what will be the result of bringing cheap power into the city. With the Great Lake harnessed it will be possible to generate enough power to run the whole of the Government Railways, even those in the remotest part of the State, and then have enough left over for the industries in the city and other places. With the low rates to be charged it will be possible to build up industries here to supply the needs of other parts of Australia. Amongst the few industries which I hope to see established is the manufacture of iron and steel by electric furnace, the production of aluminium, nitrates, and calcium carbide. Just as the power at the lake is practically illimitable, so is the application of that power industrially also illimitable. In conclusion, I may say I look upon the proposition to harness the lake as one of the soundest."

In connection with this matter gratifying progress is being made with the details of a scheme for utilising the water power for industrial purposes. The Complex Ores Company, of Melbourne, which have acquired the powers to instal a plant for the production of electricity, state that units of 5,000 h.p. will be installed as required. At the fall into the Ouse, where the power station will be located, metallurgical works are to be erected, and run by the company. This will gradually absorb one unit of 20,000 h.p. The plant to be installed will be of the latest type and design, and as much as possible will be made in the Commonwealth. It is estimated that a capital outlay of over £200,000 will be required to carry out and complete the first unit proposed to be installed, including head works, power station, transmission lines, services, and metallurgical plant.

CATALOGUES AND PRICE LISTS.

We have received the following trade publications :—

The Edison and Swan United Electric Light Company, Ltd.: Advance price list of Wires and Cables, being a supplement to Catalogue Section V.

Charles Taylor, Birmingham: Illustrated catalogue of Spiral Chucks.

J. H. Holmes & Company: Illustrated description of the Holmes-Alderson Fire-Damp Safety Cut-out.

B. R. Rowland & Company, Ltd.: Catalogue of "Emery and Corundum Grinding Wheels and Machines," including electrically-driven types.

The General Electric Company, Ltd.: (1) "Osram Lamps," a handsome album, showing different buildings at home and abroad lighted by these lamps; (2) Section O, illustrated catalogue of Electro-Medical Apparatus; (3) Section L, Electric Bells and Accessories.

W. & R. Jacobs: Large album price list of Glass Shades and Fittings for Electric Light.

The Benjamin Electric Company: Catalogue No. L3 of Wireless Clusters, Electric Light Fittings and Electric Lighting Specialities.

Schaffer & Budenberg: "Self-contained and Direct-reading Electrical Pyrometers."

Frederick Hodgson: Leaflet, The Ideal Electric Dinner Light.

St. Helens Cable & Rubber Company, Ltd.: Price List of Association and of Non-Association Cables.

British Aluminium Company, Ltd.: Leaflet on the Physical, Mechanical and Electrical Properties of Aluminium.

Hart Accumulator Company, Ltd.: Illustrated price list of Lighting Type Cells and Patent Non-Corrosive Terminals.

Credenda Conduits Company: Pamphlets "Signs of the Times," describing and illustrating the "Venner" patent signs.

The British Thomson-Houston Company, Ltd.: Illustrated description and price list of the B.T.H. Mazda lamps.

Donovan Bros.: (1) Illustrated price list of Electric Light Accessories; (2) Cable Conduit and Casing.

The Electric Construction Company, Ltd.: Large illustrated pamphlet on "Machine Tool Driving by Electricity.

DIARY.

MONDAY, NOVEMBER 7.

LEEDS UNIVERSITY ENGINEERING SOCIETY.—Mr. E. R. Matthews: "The Use of Reinforced Concrete in Engineering Construction in America."

TUESDAY, NOVEMBER 8.

INSTITUTION OF ELECTRICAL ENGINEERS.—Manchester Section. At the Physical Laboratory, Manchester University, at 7.30 p.m. Mr. C. F. Smith: "Irregularities in the Rotating Field of the Polyphase Induction Motor."

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION.—Committee Meeting to be held at Balfour House, Finsbury-pavement, at 2.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS (GLASGOW SECTION).—At the Rooms, 207, Bath-street, Glasgow, at 8 p.m., the chairman, Mr. Sam Mavor, will deliver his inaugural address.

THURSDAY, NOVEMBER 10.

INSTITUTION OF ELECTRICAL ENGINEERS.—At the Institution, Victoria-embankment, London, W.C. Inaugural Address by the President, Mr. S. Z. de Ferranti.

FRIDAY, NOVEMBER 11.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, South Kensington, at 8 p.m. Dr. C. Chree: "On the Supposed Propagation of Equatorial Magnetic Disturbances with Velocities of the order of 100 miles per second." Mr. J. S. Dow: Exhibition of a Brightness Photometer.

SATURDAY, NOVEMBER 12.

GLASGOW TECHNICAL COLLEGE SCIENTIFIC SOCIETY.—At 7.30 p.m., Mr. Robert Lang, M.I.Mech.E., on "Modern Lathes and Methods."

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SOME NOTES ON AERONAUTICS.*

By Z. Y. Lee.

This paper deals only with the fundamental principles of aeronautics and a brief account of developments.

In the art of flying there are two principal divisions, *i.e.*, aero-statics and aero-dynamics. The former refer to "lighter-than-air" and the latter to "heavier-than-air" machines. Relative advantages and disadvantages of the two types.

The art of aviation is not so new as is generally supposed. The design of an airship or an aeroplane is only an application of mechanics and some knowledge of the physical properties of the air.

Early attempts at lighter-than-air machines. Fire balloons. The Montgolfier brothers.

A "dirigible" is a balloon designed to give the minimum amount of head resistance, so as to enable it to be propelled mechanically instead of being at the mercy of the wind.

An airship has to be governed in three directions, *i.e.*, vertically, longitudinally, and laterally.

Different designs to secure minimum head resistance.

Heavier-than-air machines. Lilienthal, the "father of modern flying" in Europe. Langley, Chunnti, and Pilcher, also great pioneers of mechanical flight. In "heavier-than-air" machines there are the same number of dimensions to be governed as in the case of the lighter-than-air type. Aeroplanes classed according to the number of planes.

Various methods of finding the resistance of an inclined plane—(i) by moving plane in still air; (ii) by placing the plane in an air current. Theoretically, the results should not agree, but for all practical purposes the two methods are identical.

The advantage gained by combining the two types of air-craft.

LIGHTING OF BERMONDSEY.

A somewhat extraordinary resolution was passed at the last meeting of the Bermondsey Borough Council. The resolution was on the recommendation of the Electricity and Street Lighting Committee, to the effect that application should be made to the Board of Trade for a Provisional Order authorising the Council to supply electricity for public and private purposes within the parishes of St. Olave, St Thomas, St. John and Horsleydown.

The extraordinary nature of the proposal lies in the fact that the Board of Trade are petitioned for powers, which it is against all precedence to grant, and upon which the Board of Trade have already put their veto on three previous occasions. Two companies are already supplying in the district, viz., the County of London Electric Supply Company, Limited, and the London Electric Supply Corporation, Limited. The area is exhaustively provided for in the matter of electric light and power. It is against all precedence for the Board of Trade to allow a third party to come in, much less a rate-aided third party.

The first two applications of Bermondsey for these powers were tried and dismissed by the Board of Trade, mainly on the principle involved. Notwithstanding these defeats, the Council once more approached the Board of Trade, who on this occasion decided the case on merits from the point of view of the consumer and the general financial aspect of the proposal. The examination showed that the scheme, as put forward, would only mean loss of money to the Corporation, that the companies were doing their duty, that there was no opening for a third party to supply, and, further, that the companies were in a better position to cater for the needs of the district than the Council, and, as a matter of fact, were actually supplying consumers in St. Olave at a cheaper rate than the Bermondsey Borough Council were supplying consumers within their existing area. The application was therefore again dismissed. Needless to say, the Parliamentary costs incurred in these three successive applications have been very considerable and notwithstanding the very explicit opinion of the Board of Trade as expressed in these decisions, and based upon a most minute investigation, the Bermondsey Council have decided to once more enter the field. A further curious point is that the Council are even in a weaker position than previously to make such a claim, while, on the other hand, the companies affected are in a stronger position. The scheme, of course, has been very strongly opposed, and, in fact, only scraped through Council, the vote being 28 to 23.

It may, therefore, be thoroughly promised that the Bermondsey Council will get nothing from their venture other than another veto, supplemented by a large bill of costs.

* Abstract of a paper to be read before the Northampton Institute Engineering Society, Nov. 4, at 5.45 p.m. R.A. Boswall, Esq., B.Sc. in the chair.

INSTITUTION OF ELECTRICAL ENGINEERS.

Students' Section.

The opening meeting of the Students' Section will take place on Wednesday, November 16, in the Lecture Theatre of the Institution, Victoria-embankment, W.C., at 7.45 p.m. An address will be given by Mr. C. H. Wordingham, M.I.E.E.

All students of electrical engineering are invited to attend this meeting, whether members of the Students' Section or not. Gentlemen desirous of attending, who are not members, are requested to send their names to the Hon. Secretary (address below), not later than Tuesday, November 8.

Programme for the Session 1910–1911.

Meetings will be held in the Lecture Theatre of the Institution, Victoria-embankment, W.C. They will commence at 7.45 p.m.

1910.

Nov. 16.—Opening Address, by C. H. Wordingham, Esq., Member.

,, 30.—J. C. Rennie: Tramway Brakes and Break-gear.

Dec. 14.—J. F. Shipley: Progress in Arc-lamps.

1911.

Jan. 19.—P. R. Coursey: Wireless Telegraphy, with special reference to "Short-spark" Methods.

Feb. 1.—H. Clark: Telephony.

,, 15.—H. C. Mary: Dry-core Lead-covered Telephone Cables.

March 15.—R. C. Plowman: Exhaust Steam Turbines.

April 12.—J. M. Bloomfield: Overhead Lines for Transmission of High-Tension Electrical Energy.

,, 26.—J. B. Sparks: Electric Traction for Main Line Railways.

May 3.—Annual General Meeting. Election of Officers and Committee for Session 1911–1912.

,, 3.—A. E. E. Cheal: Some New Zealand Electric Plants.

No programme of visits has been arranged, but suggestions with regard to visits are invited, and should be sent to the Hon. Secretary, D. Betts, 3, Fordwych-road, London, N.W.

PATENTS.

Variometer for Electrical Oscillations.

8018.—1910. G. G. von Arco & R. H. Rendahl, Berlin. The variometer is composed of a number of pairs of partial variometers of equal self-induction assembled together in such a manner that in the position of the greatest self-induction the partial variometers have an inducing action one upon another, so that the maximum value is larger than the sum of the self-inductions of the individual partial variometers, while in the position of smallest self-induction the partial variometers are so arranged relatively one to another that the total self-induction is very nearly zero.

Automatic Telephone Systems.

7851.—1910. Deutsche Telephonwerke, G.m.b.H., Berlin. This apparatus for sending current impulses is automatically limited in operation, and is, therefore, claimed to be particularly applicable to subscribers' stations on automatic telephone systems. The adjustor device for driving a contact mechanism also varies the position of stops so that they limit the motion of the contact mechanism and produce the required number of contacts.

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Polyphase Electric Series Motors.

10172.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. The object is to provide reversing means for motors with or without a separate exciting winding. The direction of the rotation of the main field is reversed simultaneously with the reversal of the direction of mechanical rotation in such manner that the direction of rotation of the main field is always the same as the mechanical direction of rotation.

Alternating Current Dynamo Electric Machines of the Commutator Type.

10692.—1910. ALLGEMEINE ELEKTRICITATS GESELLSCHAFT, Berlin. This improved method of controlling alternating current commutator motors of the type provided with a working winding on the stator and on the rotor consists in regulating the potential impressed upon the working winding, partly by a device under the control of the operator, and partly by automatic devices dependent for their operation upon the speed of the machine. The total potential impressed upon the machine is regulated by a device controlled by the operator, while its distribution upon the rotor and stator and the regulation of the potential impressed upon the commutating coils is automatically effected.

Electro Magnetic Clutches.

12259.—1910. E. C. H. T. LUGARD, Chester. The contacting masses of magnetic material are extended laterally and carry the clutch parts beyond the exciting coil. By this means it is possible to make the clutch parts of any desired diameter, and as they are neither in nor near the magnetic circuit, the energy dissipated in them does not cause heating of the flux-carrying material.

Electric Signals.

13985.—1910. SIEMENS & HALSKE, A.G., Berlin. This is an improvement in receiving and registering appliances for electric signals in which the arriving signals are recorded upon a paper strip by mechanical means. In order to enlarge the recorded signals optically and to project them in such a manner that the signals can be read from a distance, the source of light is combined with a system of optical lenses and reflecting surfaces so arranged that the required enlargement is obtained within a small horizontal dimension.

Automatic Railway Signalling.

14925.—1909. H. D. PATTERSON, Mount Vernon, U.S.A. This is an improved signalling system for electric railways in which the rails are electrically continuous and demarked in blocks each supplied by alternating signal controlling line current of constant and equal phase and comprising an independent local signal actuating circuit. The object is to control the local signal circuits by energising multicoil polyphase relays by means of a difference in phase in the current passed through the separate coils of the relays, and to produce the difference of phase within the relays mainly by branching the signal controlling current and leading one branch through a portion of the track rails in order to utilise the counter electromotive force caused by the inherent impedance of the rails to alter the phase of current in this track branch. One or more coils of the relays has connections direct with the source of signal controlling current, while other coils are connected to the track rail branch.

Miners' Electric Safety Lamps, with Oil Test Lamp Attachment.

19359.—1909. J. G. PATTERSON, Darlington, Durham. The electric lamp has an oil safety lamp attached for the purpose of indicating the presence of gas or fire damp in the mine. The oil lamp is very small in construction, and is designed to give just sufficient light for testing purposes. The lamp is ignited and extinguished by operating an electric switch enclosed in a case with the oil lamp.

Electrical Connectors.

20035.—1909. FELD BROS. & COMPANY, LTD., & B. F. SOBOTKA, London, E.C. This connector for electric conductors comprises a conical socket provided with a central cylindrical pin which engages a split plug. The plug is conical, and has a central cylindrical hole to receive the pin. The plug fills the sockets and excludes the air, which, if it were allowed to remain, would cause expansion on heating and loosen the plug.

Electro Deposition of Metals.

22374.—1909. S. O. COWPER-COLES, Westminster, S.W. This improved process for rendering brittle electro deposits of metal sufficiently ductile to allow of their removal from the cathode without cracking, consists in immersing and rotating the mandrel with the deposit in a bath of molten lead. This causes a sufficient quantity of hydrogen gas to be liberated from the iron to render it ductile enough to be removed from the mandrel without splitting.

Telephones.

22580.—1909. G. R. WEBB, Baltimore City, U.S.A. In this electric circuit for use in telephone central stations, one pair only of the microphone cells of a special transmitter are inserted in each of two arms of a Wheatstone bridge network. The other two arms are provided with condensers or resistances. A source of current is placed in one diagonal, and the distant circuit without the inclusion of an induction coil in another. This enables undulatory currents to be produced in the distant circuit corresponding to the vibrations of the diaphragm.

Electric Train Lighting.

22611.—1909. H. LEITNER, Woking. This is an improvement in electric train lighting systems of the type in which a practically uniform voltage is obtained by means of a looped lamp connection. The improvement consists in the employment of switches on the generator coaches and in parallel with each other on the dependent coaches for effecting the looping.

Electric Fire Alarms.

22617.—1909. H. W., & H. W. HEADLAND, Leyton. The alarm comprises a source of electricity and a switch adapted when in the closed position to short circuit or open the circuit of electricity and to connect the line wire to earth, and when in the operated position to connect the source of electricity to the line wire and to break the earth connection.

Wireless Telephony.

22640.—1909. A. BURNS, Portobello, N.B. This is an improvement in transmitters for signalling by means of electric waves in which the oscillations set up in the antenna are produced by the Poulsen arc system. The improvement consists in forming the small arcs between several pairs of closely adjacent electrodes arranged in series so as to produce an approximately ring-shaped compound arc, which is placed in the field of a magnet whose windings are reversed by rapidly alternating currents.

Ship Propulsion.

26346.—1909. GENERAL ELECTRIC COMPANY, Schenectady, U.S.A. This is an improvement in means for reversing the propeller shaft of ships in which the propeller is driven in a forward direction by means of an electric motor supplied with current from a generator driven by a high-speed turbine. A separate reversing turbine is provided, coupled to the propeller shaft either directly or through a speed-reducing gear.

Electrical Standard Resistances.

27335.—1909. W. R. BOUSFIELD, Hendon. A glass tube is filled with mercury and furnished with platinum terminals sealed into the tube. The tube may be straight or in the form of a compact spiral. Communicating with the tube is a thermometer tube which is partially filled with mercury, so that the compound tube with its mercury acts not only as a resistance but as a thermometer. The tube has a graduated scale for indicating the resistance. The apparatus is usually placed in a bath, and when considerable currents are continuously used water is circulated through the bath to keep the mercury sufficiently cool.

Electric Stencil Brand Cutter.

2998.—1910. COMPAGNIE GENERALE DE PHONOGRAPHES, Cinematographs et Appareils de Precision, Paris. The machine comprises an electro-magnet and vibrating armature adapted to give a high period of vibration with small amplitude of motion to the armature by means of an alternating current in combination with a mechanical device adapted to actuate a cutting tool at a speed four times the alternations of the current employed.

Packages for Electric Lamps.

3900.—1910. A. H. STEVENSON, Manchester. The package comprises a box to one end of which a ring is attached. The ring has slots to receive the lugs on the lamp to be supported in the package.

Ventilation of Electric Accumulator Cells.

4567.—1910. A. B. PESCATORE, & TUDOR ACCUMULATOR COMPANY, LTD., London, W. The cell has a large central aperture in the lid and also two small apertures. V-shaped pipes lead from the small apertures to the corners of the cell, so that the gases are drawn from all parts of the cell and caused to flow through the pipes and out of the apertures.

Control of Electric Circuits.

4696.—1910. A. H. OLMSTEAD, Le Havre. This is a system of control for apparatus of the kind in which a drum controller co-operates with mechanically-operated individual switches in such a manner that all circuits carrying current are broken by the mechanically-operated individual switches only. These switches, in addition to the usual opening and closing means are also provided with auxiliary means which can be operated to open the individual switches at any time and prevent them from being closed until desired.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

Old Series, Vol. LI.
New Series—No 20, Vol. XLVI. LONDON, NOVEMBER 11, 1910. Price 3d.
Registered at the General Post Office

NOTES.

Electricity in Mines.

We publish in this issue two important items connected with the use of electricity in mines. In the illustrated article on the Holmes-Alderson apparatus we see how electricity is being utilised for the safety of mines and miners. In the brief report on the quarterly meeting of the Federation Board of Miners and Enginemen and Firemen held at Chesterfield, we have an arresting glimpse of the miners' view of the dangers that electricity brings to those working underground. While some of the delegates spoke at large against electricity, Mr. Haslam, M.P., and the resolution passed, fairly represented the feeling of the meeting, and that was, that electrical appliances should be placed in the keeping of thoroughly qualified persons. Among miners there is an impression, which is confirmed by evidence at too many inquiries, that unqualified persons are either employed in connection with, or have access to, the electrical appliances.

Electricity Lighting and the L.G.B.

It has been noticed of late that the engineering inspectors of the Local Government Board ask for very definite figures when a local authority desires to raise a loan in order to transfer street lighting over from gas to electricity. One of the inspectors, indeed, in stating his requirements as regards particulars showing what saving would be made by the ratepayers as a result of the transfer, said that if a Council asked for a loan to supersede a system already in vogue, they must demonstrate how it was going to advantage the ratepayers. In some quarters it has been inferred from this that the Local Government Board did not favour the use of electricity for public lighting. Of course, this is a complete misunderstanding of the position. The Board act as guardians of the public purse, and they naturally are against the idea of waste. If the capital invested in gas lamps and so on is to be written off as loss—and sometimes to the detriment of another department of the local authority—then the Board, naturally enough, require evidence that the waste involved will at least be made good by the saving effected. Improved service is not altogether a convincing argument from this point of view. As a matter of fact, with the new methods of street lighting, the figures asked for are usually easily enough brought forward and justified.

British and German Methods.

We have had many comparisons of British and foreign methods in the electrical manufacturing industry. Perhaps one of the most interesting and noteworthy appeared in the pages of our contemporary, "The Financial Times," After referring to the bigger dividends paid by the German firms, it is pointed out that British firms, as a rule, aim at keeping their machinery in first-class working condition, while the Germans are content to keep theirs up-to-date. The great difference, however, is, in the opinion of the city paper, the way in which the workmen are treated.

Benefits of Bonuses.

We have seen from the various inaugural addresses by electrical engineers that the German worker receives a far more practical education than our own men. Now the "Financial Times" declares emphatically that there is one "difference that is bound to have very great influence on the manufacturing efficiency of the companies. In German balance sheets the bonus to staff is of universal application under the heading 'tantiem,' but among the English companies named it only appears in one, which company also allotted Ordinary shares to their staff. Wherever the above items figure in English balance sheets, in this or other trades, the companies show material signs of healthy prosperity. The mere fact of bonus being given to the staff or even their being allowed to hold shares in the company, is bound to make those members of the staff feel, if possible, a still keener interest in the prosperity of the company they are working for. This is especially true of the electrical manufacturing industry, where so much depends on the technical ability of the staff, that anything which lends additional incentive to the staff cannot help being beneficial to the company's success." An opinion of this kind, coming from such a source, should not be overlooked.

The Isolation of an Ion.

Mr. H. A. Milliken, at the recent meeting in Chicago of the American Electro-chemical Society (writes our New York correspondent), presented a paper on the isolation of an ion and a precision measurement of its charge. Describing the method of isolation, Mr. Milliken said oil is sprayed through an atomizer so that it can be obtained in minute drops, and one of these is admitted into the air space between the horizontal plates of a condenser. The plates are 16 millimetres apart, and may be charged to any desired difference of potential up to 12,000 volts. The drops of oil are so small that they almost float in the air, descending very slowly under the action of gravity. The motion of the droplet is observed through a telescope. The drops usually possess an electric charge when first observed, and by creating the electrostatic field the motion can be accelerated, retarded, or even reversed, according to the strength and direction of the field. The observed velocity serves to determine the charge carried by the particle. This charge is found to vary from time to time, due to the acquisition of positive or negative ions from the surrounding air. The changes in charge are found to always consist of a certain definite small quantity or an exact multiple of this, and the original charge is invariably an exact multiple of this minimum charge. The author concludes that this minimum charge is the elementary quantity of electricity, and its value is found to be $4{\cdot}93 \times 10^{10}$ in ordinary units of electric quantity. The author concludes that the majority of the ions of ordinary dust-free air, either positive or negative, carry the elementary charge, but that some ions carry multiple charges. Interesting confirmation of the kinetic theory of gases was also obtained, and it was found necessary to modify the law of Stokes for the velocity of minute spheres falling in air. The accuracy of the result is at present limited by the uncertainty of our knowledge of the viscosity of the air, but it is considered correct to about 0·2%.

PHYSICAL SOCIETY'S EXHIBITION.—The date of the annual exhibition held by the Physical Society of London, which was fixed some time ago for December 13, has been altered to Tuesday, December 20. The exhibition will be open in the afternoon as well as in the evening.

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SAFETY FIRE-DAMP CUT-OUT.

The Holmes-Alderson Patent.

During the recent general meetings of the Association of Mining Electrical Engineers in Newcastle-on-Tyne a very interesting demonstration was given at Armstrong College of the working of the Holmes-Alderson Safety Fire-Damp Cut-out, which attracted a considerable degree of attention, and by the courtesy of Messrs. J. H. Holmes & Company, of Newcastle-on-Tyne, the makers of this apparatus, we are able to illustrate and describe this gear.

Briefly, the apparatus consists of firstly a detector, shown in the lower half of the illustration Fig. 1, and the cut-out, shown in the upper portion of the photograph. The detector is made of two strips of metal arranged as shown in the diagram of connections, Fig. 2, so that the outer ends of these strips are held firmly while their free ends overlap. Each strip is made up of two pieces of dissimilar metals, as, for example, steel and brass, having

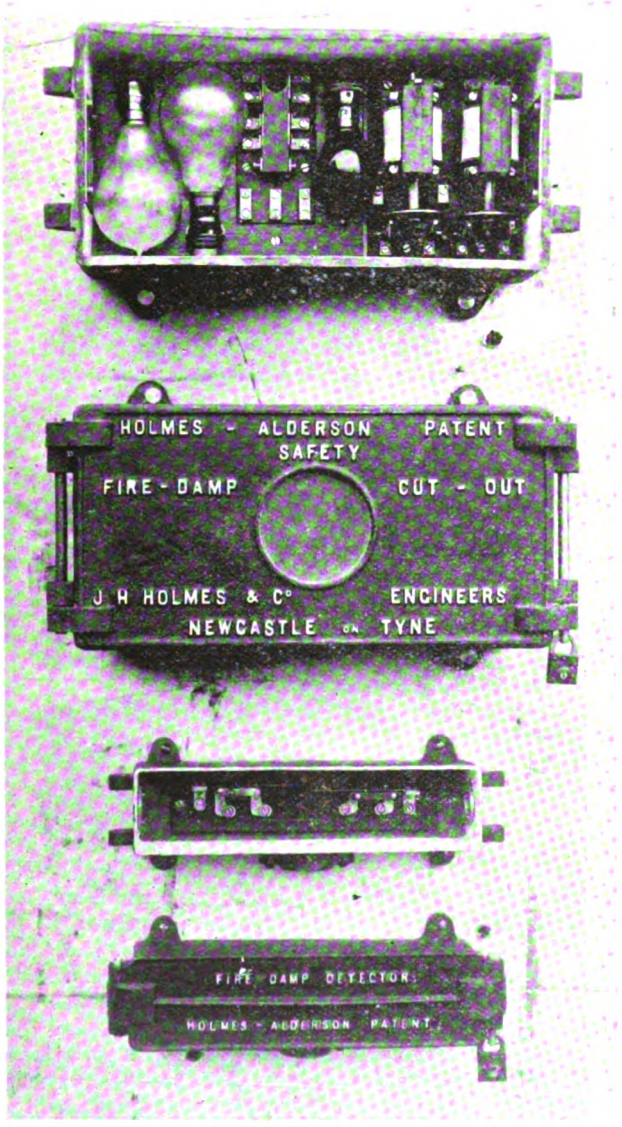

FIG. 1.

different co-efficients of expansion, hence any heating of these strips causes them to curve. Under usual conditions the free ends remain out of contact with one another. Coils of thin wire are placed below the strips, the upper strip being heated by an ordinary resistance coil, the lower one having below it a coil of platinum. These two coils are placed in series in a circuit passing to the cut-out box.

It will be known by our readers that platinum possesses catalytic properties; that is to say, in the presence of hydrogen it increases in temperature. So long as there is no hydrogen in the vicinity of the detector the heating of the two coils remains the same and the thermal strips remain out of contact. If hydrogen, due to marsh gas or fire damp, is present the platinum coil heats up more strongly and the lower thermal strip comes into contact with the upper, completing a circuit by which current passes through the circuit marked SS on the diagram to a magnetic solenoid switch W.

It will be seen that the lifting of the core of this solenoid opens a circuit on two spring contacts which normally short circuits a red lamp danger signal R. The operation of the detector therefore puts the red lamp into series with the heating coils and the white lamp of 32 or 50 candle-power which is normally alight, hence the white lamp is practically extinguished and the heating coils cool down. The danger signal therefore consists of the light shining through the porthole changing from white to red. Moreover, by putting the red lamp into series the current in the second solenoid X is so much reduced that the core of this solenoid drops opening the circuit on a line passing to the starting switch of any motor whose operation it is desired to suspend owing to the presence of fire damp. In the arrangements shown in the diagram the circuit of the solenoid control on the main switch of a motor is interrupted and the switch therefore flies to its off position, and if this switch is enclosed in a locked case no one can restart the motor until the core of the solenoid W has been reset. This core is locked into its top position when once it has been drawn up by means of a catch so that even if the thermal strips break contact after once operating the main motor solenoid cannot be closed until the fire damp cut-out box has been opened and the lock on the core of W released. In practice the key of the cut-out box is held by a responsible official, who has to take means by ventilation, etc., of removing all traces of fire-damp from the portion of the mine where the detector is placed before he resets the solenoid W.

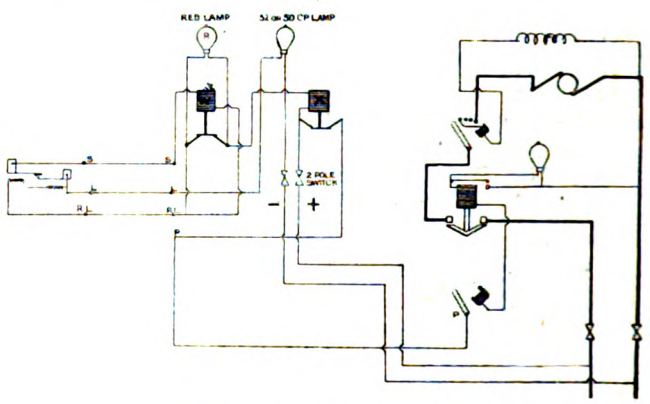

FIG 2.—DIAGRAM OF WIRING.

It will be seen that the detector is so small that it can easily be fixed in any location where fire damp is suspected, as the case is only about 12 inches long, 3 inches deep and 3 inches wide. It is provided with wire gauze protected openings to allow free percolation of the surrounding atmosphere while retaining any flame due to the heating of the coils or a spark at contact. From this detector three wires run to the cut-out box, which can be placed in any convenient location, three more wires being used to connect the cut-out box to the motor control and to the main supply. It will be seen from the diagram that current is taken from behind the main fuse to the motor in order to allow the detector to operate even when the power installation is shut down as, for example, at week-ends, when an accumulation of gas might very conceivably occur. It is also possible to combine with the apparatus an audible as well as a visible danger signal by means of a bell system operated from the detector, and it will be seen that the apparatus presents a novel and interesting method of dealing with what has always been regarded as a most serious danger in the use of electrical appliances in mines. The makers of the apparatus will be most pleased to answer any further question regarding the technical aspects of the question as applied to mining engineering.

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CORRESPONDENCE.

All communications intended for the Editor should be addressed "THE EDITOR, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

IRON AND STEEL AND ELECTRIC POWER.

To the Editor of the ELECTRICAL ENGINEER.

SIR,—I find in your issue of September 30th, 1910, page 363, a paper by Mr. Elink Schuurman, Baden, dealing with the Economical Speed Regulation of Induction Motors. In this paper the figures 2, 3 and 4 are stated to give an illustration of the "Scherbius" method of regulation, whereas Fig. 5 is called the "Kramer"

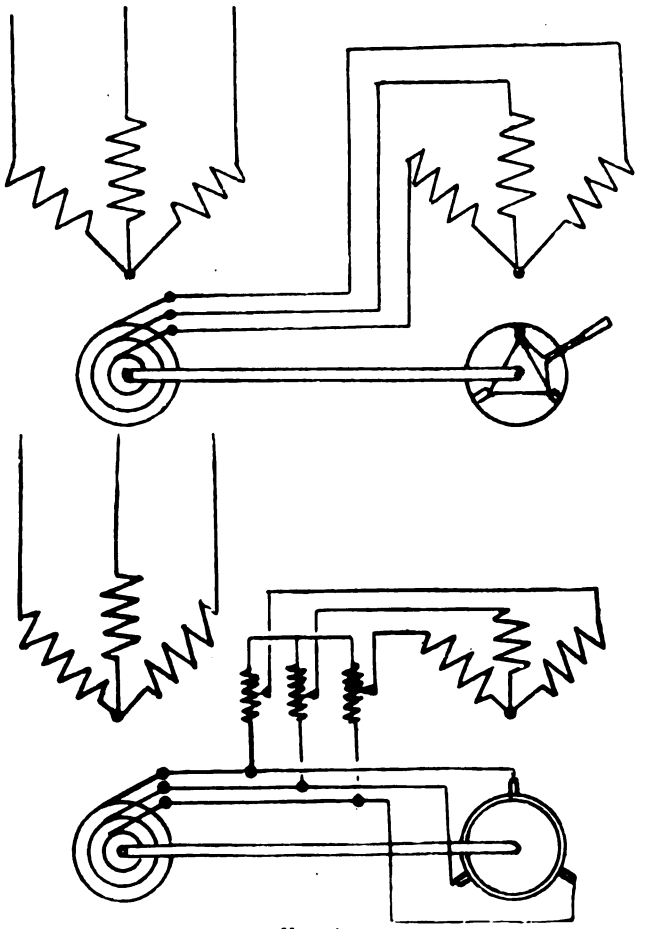

FIG. 1.

regulation. I therefore take the liberty of informing you that the paper contains various errors as to the inventors of the various systems. The Cascade arrangement with commutator motor, Figs. 2 and 3, was invented by the undersigned and is protected by the German Patent No.

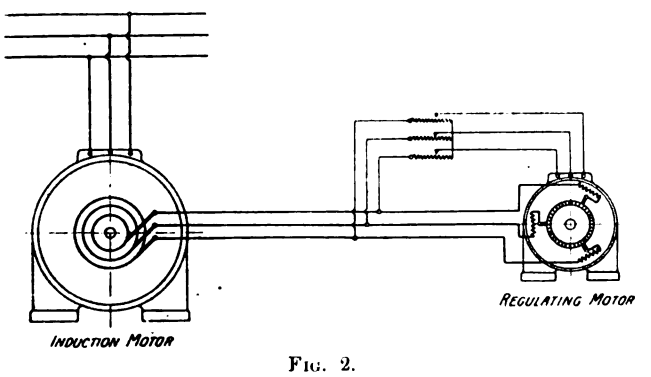

FIG. 2.

169453 belonging to Messrs. Felten and Guilleaume Lahmeyerwerke, dated 1905. The enclosed Fig. 1 gives the drawing belonging to this patent specification. The arrangement 2 and 3 in the paper should, therefore, be called the "Kramer" method, as well as the arrangement shown in Fig. 5, which was also invented by me. Only the arrangement according to Fig. 4 is given by Dr. Scherbius and is protected by the German Patent No. 179525, dated July 1905.

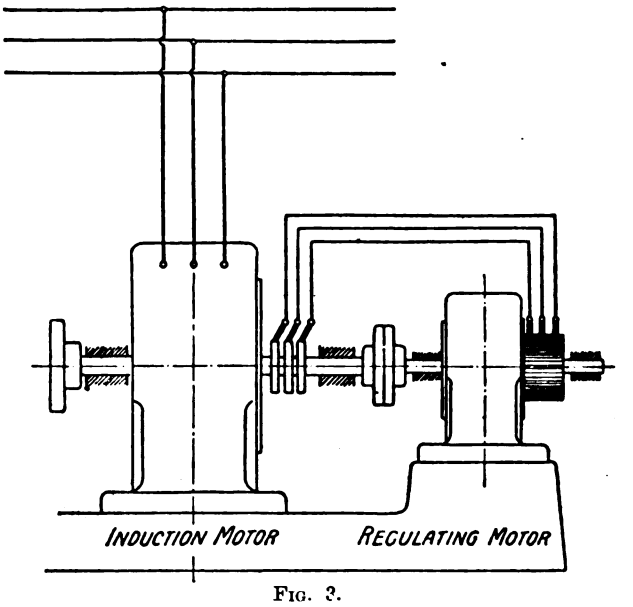

FIG. 3.

I also take the liberty of drawing your attention to the enclosed Fig. 6, which shows an invention by Mr. Jonas

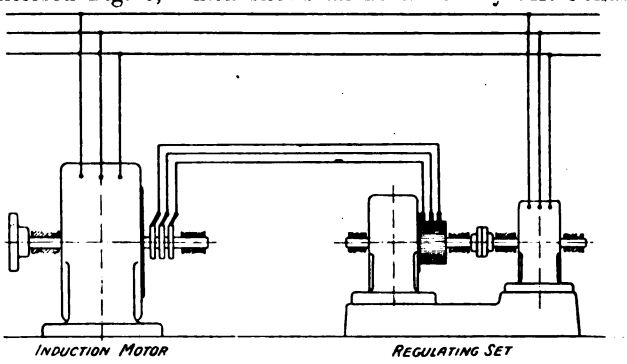

FIG. 4.

covered by German patent from January 8, 1905, also belonging to Messrs. Felten and Guilleaume Lahmeyerwerke.

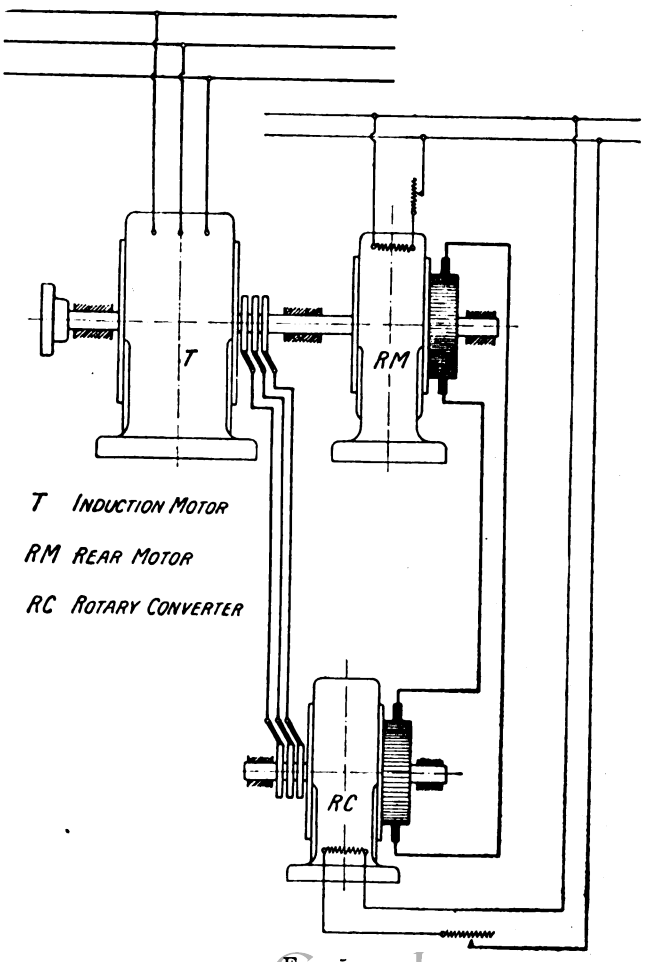

FIG. 5.

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There are, therefore, two "Kramer" methods of speed regulation, namely, the direct coupling of a three-phase commutator motor with induction motor, according to the enclosed Figs. 2 and 3, and direct-coupling a continuous current motor on to the shaft of the induction motor, transforming the slip energy by means of a converter into continuous current. With this arrangement the speed is regulated by altering the field of the direct-coupled continuous current motor. In both systems the slip energy is returned to the shaft of the induction motor. They differ from the invention of Mr. Jonas in so far that they return the slip energy to the shaft of the induction motor and not by means of a motor generator to the supply, and at the same time permitting of a wide range of regulation.

The invention of Dr. Scherbius as per enclosed Fig. 4 is, therefore, a combination of the "Jonas" method and the "Kramer" Cascade arrangement.

The comparison given on page 366 is, therefore, not a comparison between the "Scherbius" method and the "Kramer" method. What is said applies to the "Kramer" Cascade system and compares with the "Kramer" Converter Cascade system, but even with this correction the comparison drawn is not quite correct.

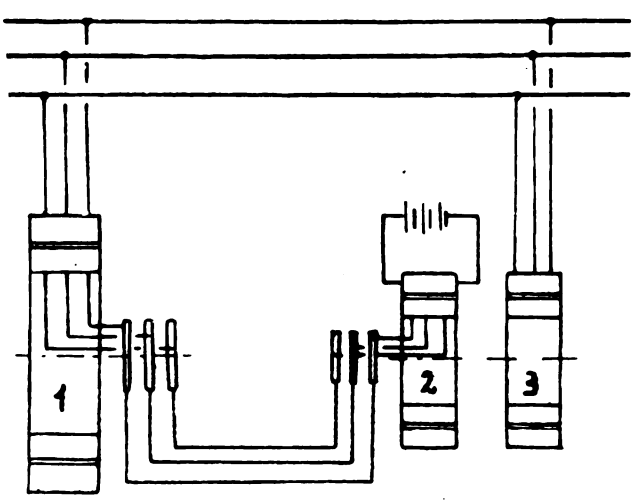

Fig. 6.

Whether one system or the other is to be recommended depends upon so many circumstances that it is impossible to arrive at a decision until they have all been gone into and further examined. It also depends largely upon further improvements in the three-phase commutator motor, for instance, for the time being nearly all installations over 1,000 h.p. are being carried out on the "Kramer" Converter Cascade system.

I should be glad if you would publish these remarks, together with the enclosed figures.

Yours, etc.,
CH. KRAMER.

Felten & Guilleaume-Lahmeyerwerke,
Acten-Gesellschaft, Frankfurt-Main.

[The paper was one read before the Iron and Steel Institute in September.—ED.]

POST OFFICE TELEGRAPH AND TELEPHONE FINANCE.

SIR,—That tardy annual, the Postmaster-General's Report on the Post Office for the year ending March 31, has just made its appearance. A few years ago it was available in August, but it is gradually becoming a Christmas publication.

In view of the approaching creation of an exclusive Post Office monopoly in the telephone, the financial results of the present telegraph and telephone work of the Post Office are of interest to business men and political economists. Summarised, they are as follows :—

CAPITAL EXPENDITURE.

Telegraphs	£18,523,019
Telephones	£10,138,128
Total	£28,661,147

GROSS REVENUE.

Telegraphs	£3,166,192
Telephones	£1,391,377
Total	£4,557,569

WORKING EXPENSES.

Telegraphs	£3,568,203
Telephones	£1,026,933
Total	£4,595,136

The excess of expenditure over revenue for the year was therefore £37,567.

The working expenditure of the telegraphs was 113 per cent. of the gross revenue.

The working expenditure of the telephone was 73·8 per cent. of the gross revenue.

The working expenditure of the combined undertakings was just over 100 per cent. of the gross revenue.

All capital charges, on 28½ millions of capital, have to be met from other sources than the earnings of the combined undertakings.

Interest on the original capital of the telegraphs, £10,800,000, is paid out of the Consolidated Fund.

On the capital added since the purchase capital account was closed, many years ago, no interest is paid.

Interest and sinking fund on telephone capital is paid partly by net telephone revenue and partly by royalties from licencees; the royalties for the past year amounted to £320,590, or almost as much as the net revenue of the whole telephone business of the Post Office.

The actual net telephone revenue, arising from the trunk line system, the London system and the Provincial systems of the Post Office, amounted to £364,444, or 3·55 per cent. on the total telephone capital of £10,138,128. The amount required for interest and sinking fund on telephone capital was £767,007, so the net telephone revenue failed to meet capital charges for the year by £402,563.

It is to a department which produces from a technical industry financial results such as these that the political authorities now propose to entrust the entire telephone business of the country.

I am, Sir, etc.,
HERBERT LAWS WEBB.

35, Old Queen Street,
Westminster, S.W.

PERSONAL.

Mr. J. Power, Chief of the Postmaster-General's Electrical Staff, Brisbane, has been appointed by the Federal Government, Electric Engineer for Queensland. Mr. Power has been succeeded at the Post Office, by his assistant, Mr. J. W. Sutton, A.M.I.E.E., whose salary has been raised from £260 to £310.

Mr. J. S. Cunnington, chief engineer and manager to Messrs. Cunnington & Harris, Ltd., is severing his connection with that firm. For the present all communications for him are to be sent c/o The Fuller Manufacturing Company, Norfolk House, Cannon-street, E.C.

The many friends in Aberdeen and elsewhere of Mr. W. R. Watt, of the Corporation Electricity Department, will be pleased to learn that he has secured a good appointment on the staff of the Electric & Ordnance Accessories Company, Ltd., of Birmingham. To mark the occasion the staff of the Electricity Department entertained Mr. Watt to supper in the Imperial Hotel. Mr. Downie presided, and in the name of the company assembled expressed the regret they felt at parting with Mr. Watt, who, during the last seven years had, by his many personal good qualities, his obliging disposition and readiness to help in any social work connected with the department, made himself a prime favourite with one and all. In congratulating him on his appointment, he asked the company to drink with him to Mr. Watt's health, happiness, and future prosperity. This toast the company enthusiastically pledged. In a characteristically racy speech Mr. Watt took occasion to thank the staff for the handsome kit bag presented to him by Mr. Bell, for the present entertainment, and last, but not least, for the many expressions of goodwill that he had received at their hands.

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LARGE GAS ENGINES AND THEIR TROUBLES.*

By Frank Foster, M.Sc.

The purpose of this paper is primarily to discuss the difficulties which have to be overcome by the makers of large gas engines. Hence it is not proposed to describe the various types and makes of large gas engines beyond giving a few brief outline descriptions for the benefit of those who may not be closely in touch with gas engine work.

Concerning ourselves merely with engines which have had some commercial success, we find six principal types or classes of large gas engines, as follows :—

A. *Four-cycle engines*—
   (1.) Single-acting horizontal.
   (2.) Double-acting horizontal.
   (3.) Single-acting vertical.
B. *Two-cycle engines*—
   (4.) Single-acting horizontal.
   (5.) Double-acting horizontal.
C. *Hydro-gas engines*—
   (6.) Four-cycle and two-cycle.

It is obvious that a great many different engine constructions can be obtained by varying the arrangement of the cylinders, and the designer has often some difficulty in choosing an arrangement in view of the frequently-conflicting considerations of cheapness, floor space, accessibility, turning quality, and fashion. These variations in cylinder arrangement do not substantially affect the type, and for the purpose of an outline description such as is given here are not of importance.

(1.) *Single-acting four-cycle horizontal engines.*—Single cylinder engines of this type constitute the world's standard for sizes up to about 250 h.p. and a few have been built of double this capacity. Even then they can scarcely claim the title of large gas engines, and will not be considered here. The tandem and double-tandem single-acting engines have, however, obtained a considerable vogue in this country, the Premier Gas Engine Company having built a large number developing about 500 h.p. per cylinder. As will be seen from Fig. 1, there are two working cylinder-ends, separated, so far as the sequence of explosions is concerned, by one complete revolution of the crank. Hence the explosions may be represented by 1010.

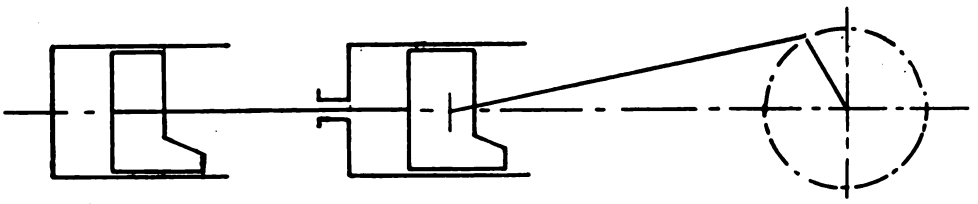

FIG. 1.—PREMIER TYPE ENGINE. SINGLE-ACTING, HORIZONTAL TANDEM, FOUR-CYCLE.

(2.) *Double-acting four-cycle horizontal engines.*—Each cylinder-end is now a working end, so that larger powers are possible than with type 1. The usual arrangement is a single-tandem engine, as illustrated by Fig. 2, which shows an engine of the Ehrhardt and Sehmer type, as made by Galloways, Manchester. The explosions are 1111. That is, each stroke is a power stroke and, apart from slight differences in the shape of the turning-moment curve, the turning quality is the same as for a steam engine, having the same number of cranks. This type of engine might almost claim to be the world's standard for large powers. It is made in this country by Galloways, Ltd., Manchester; the Lillieshall Company, Oakingates; Richardsons, Westgarth & Company, Middlesbrough; and Fraser & Chalmers, Erith, besides about 20 large firms in America and on the Continent. It is frequently referred to as the Nurnberg type, although strictly the Nurnberg type constitutes only one of several embraced by the above outline description.

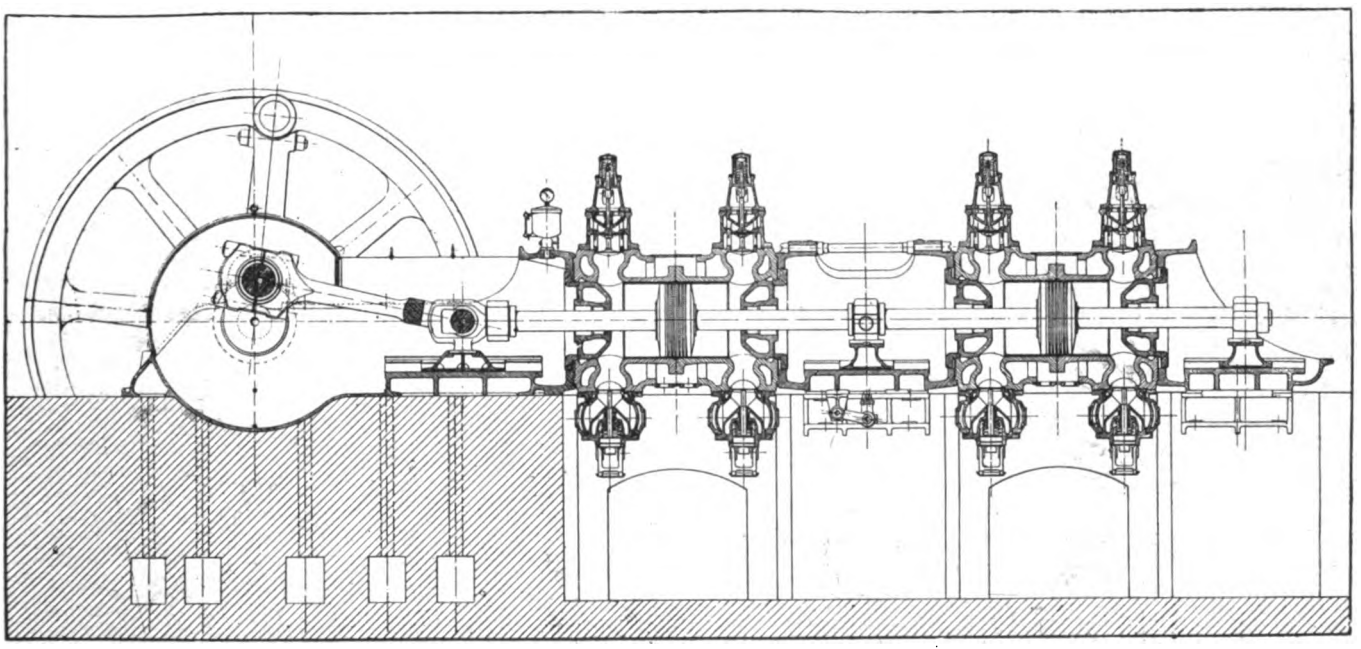

FIG. 2.—HORIZONTAL DOUBLE-ACTING, TANDEM, FOUR-CYCLE ENGINE.

It may be desirable first to state briefly the difference between four and two-cycle engines. In all four-cycle engines each working cylinder-end has one power or working stroke in four; that is, one power stroke, or one explosion in two revolutions. In all two-cycle engines there are twice this number of explosions; that is, one per revolution from each working cylinder-end. Signifying explosions by the figure 1 and blank strokes by 0, these two cycles may be represented as follows: Four-cycle, 1000; two-cycle, 1010; two figures being in each case equivalent to one revolution.

(3.) *Single-acting vertical four-cycle engines.*—These are so far all of the short-stroke, quick-revolution, or high-speed, type. Those with tandem cylinders on each crank (Fig. 3) might almost be called the British Westinghouse type, as this firm introduced and popularised it. On the Continent and in the United States this type has made no headway. Engines with one cylinder per crank are made by a large number of firms in this country, but most of them can hardly be called large engines. The tandem type has been built in sizes up to 1,000 b.h.p., this engine having four cranks and eight cylinders, as shown in Fig. 3. The sequence of explosions can easily be worked out for any case.

* Paper read at the Manchester Engineering Exhibition, October 24, 1910.

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(4.) *Single-acting two-cycle horizontal engines.*—Small engines of this type, but generally similar to the standard British four-cycle engine for small powers are almost unknown, but a single-cylinder engine with two pistons working on cranks, 180° apart and having one common combustion chamber, has gained some popularity. This is the Oechelhauser engine, which is made in this country by William Beardmore & Company, Ltd., Glasgow. The turning quality is the same as engines of type 1, and is represented by 1010 (Fig. 4).

(5.) *Double-acting two-cycle horizontal engines.*—This is known as the Korting type, and is made in this country by Messrs. Mather & Platt, Ltd., Manchester (Fig. 5). Since each cylinder has an explosion each stroke, thus, 1111, there is no point in adopting the tandem arrangement.

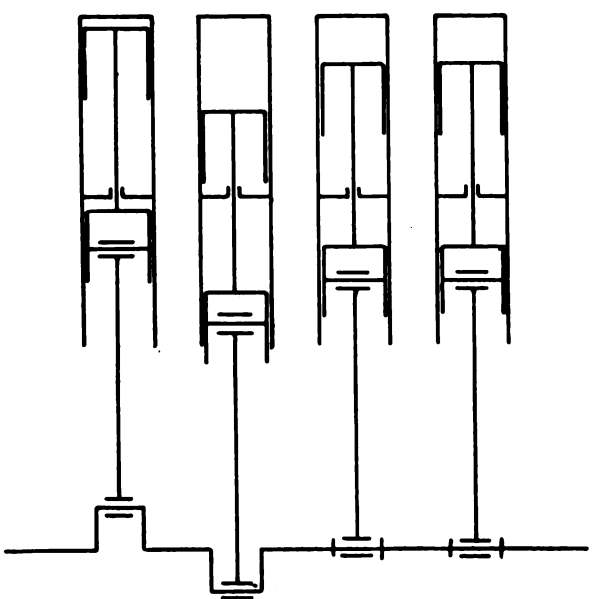

FIG. 3.—WESTINGHOUSE TYPE ENGINE. SINGLE-ACTING, VERTICAL, FOUR-CYLINDER.

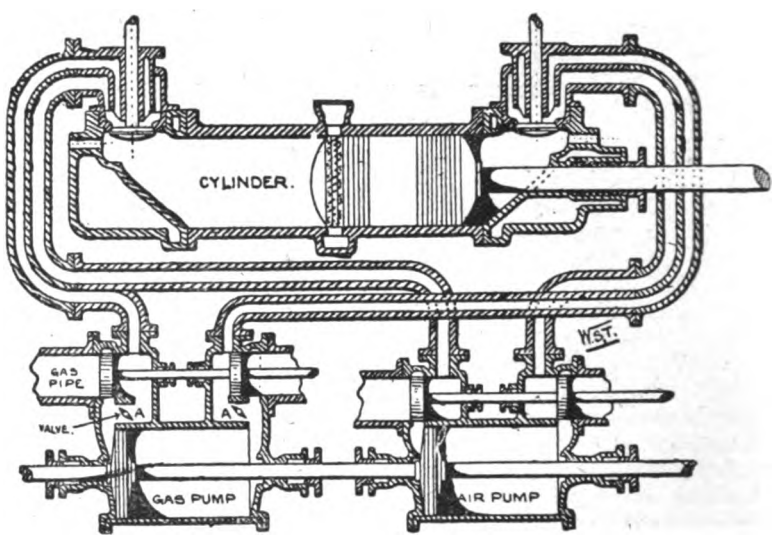

FIG. 5.—HORIZONTAL DOUBLE-ACTING TWO-CYCLE ENGINE.

(6.) *Hydro-gas engines.*—These are represented by the Humphrey pump. The action may be briefly described as follows. An explosion takes place in the combustion chamber and drives the water along the pipe and out at the discharge end; at the same time sucking in water through the valves, V (Fig. 6). The momentum acquired causes the water to shoot beyond the point required for static equilibrium, and hence it returns again, forcing the burnt gases out of the combustion chamber. In doing this it overshoots the mark and moves outwards again, at the same time sucking in a fresh charge of gas and air. On this outstroke its momentum again causes the water to overshoot the mark, and on returning it compresses the charge which is ignited and the above cycle repeated. The water is discharged into a tank or under pressure, but if mechanical or electrical power is desired it must pass through a hydraulic turbine, so that for most purposes one unit consists of a hydro gas pump and a water turbine.

Having thus briefly outlined the types of large gas engines available we will turn to a consideration of the difficulties to be met by their makers. These may be (a) constructive, (b) operative, or (c) commercial. All three are to some extent related, and the first two particularly so.

Dealing with the purely engineering difficulties first, there are certain fundamental considerations to be kept in mind. No exact measurements of the temperatures attained in gas engine cylinders have been made, but it is known that temperatures between 2,000 and 3,000° F. (say 1,100 to 1,400° C.) are regularly attained. These values are above the melting point of cast iron, and it is evident that steps must be taken by water jackets and other means to keep down the temperature of the cylinder and piston walls, valve parts, etc., as the metal would be ruined if its temperature attained anything like 2,000° F. Now, the mean temperature of the inside face of the metal increases with the mean temperature of the gases and the vigour of their scouring action with the diameter of the cylinder and the thickness of the cylinder, or other, walls; but decreases with a decrease in the jacket-water temperature, and an increase in the conductivity of the metal. Neither of these last two qualities can be materially controlled by the designer, although it is important not to work with the jacket-water too hot.

There are several ways of influencing the mean temperature of the gases—and here it should be pointed out that this mean temperature must be reckoned on a time basis, and is not solely a matter of the shape of the indicator diagram. Scavenging, that is, washing out the cylinder between explosions with cold air, if properly applied and with a properly designed combustion chamber and valve parts, gives good results at some little cost in power. If unskilfully applied it may increase the chances of cylinder troubles by increasing the temperature differences between adjacent parts and by increasing the range of temperature fluctuation.

A four-cycle cylinder, having only half as many explosions as a two-cycle cylinder at the same speed of revolution, has obviously a much lower temperature than the latter. Again, the mean gas temperature may be reduced by using a weak charge and by keeping down the maximum pressure and temperature attained on explosion. These devices are,

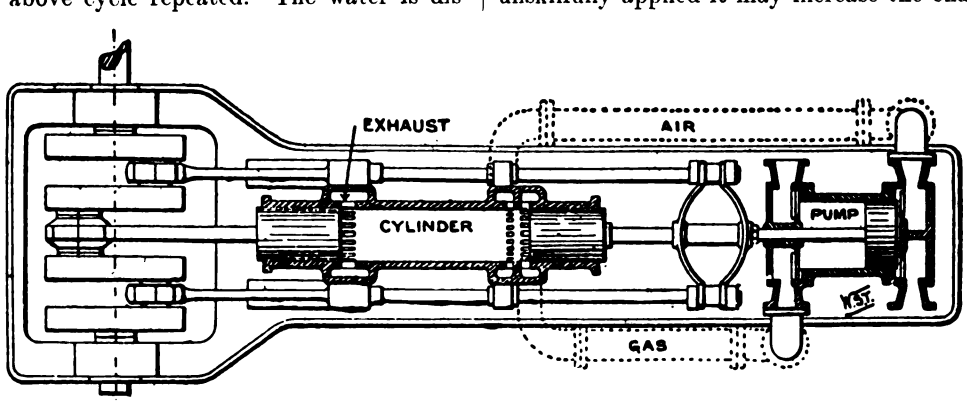

FIG. 4.—HORIZONTAL SINGLE-ACTING TWO-CYCLE ENGINE.

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in fact, adopted in all large gas engines, the maximum pressure—and with it also the maximum temperature—being reduced by keeping the compression low; present values being distinctly lower than was the case a few years ago; whilst the mean effective pressure—which is determined partly by the strength of the charge and partly by the value of the compression—is not allowed to greatly exceed 70 lbs. per sq. in. This value should not be maintained for more than a few minutes at a time—less if the engine is internally dirty—and is considerably reduced for continuous running.

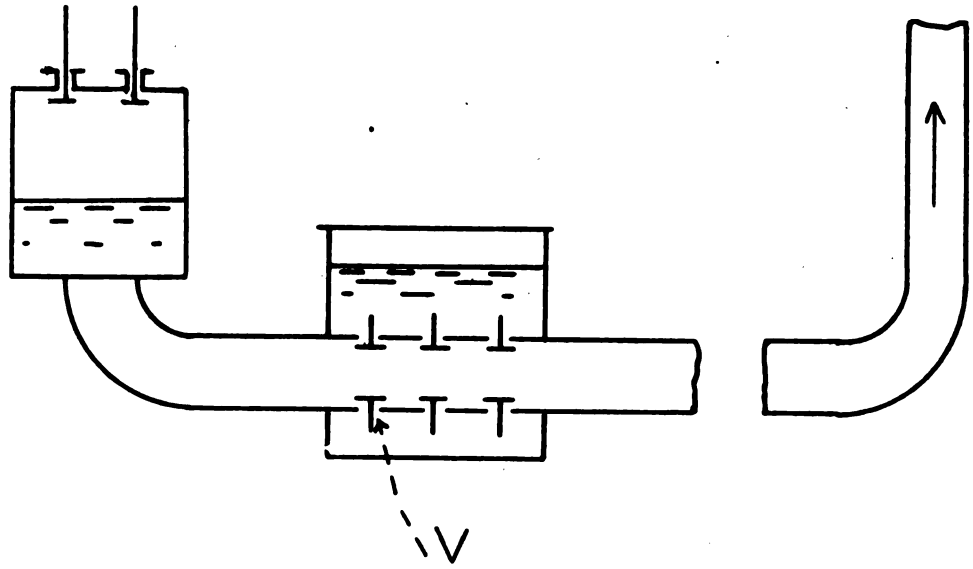

FIG. 6.—HUMPHREY GAS PUMP.

The diameter of the cylinder affects the temperature of the gases in the following way. The gases near the walls are colder than those in the body of the combustion chamber because of the cooling action of the cylinder walls. This cooling action obviously decreases as the ratio of the wall surface to gas volume decreases, and therefore is less marked in a large than a small cylinder. The action is not strictly proportional to this ratio, or it would be easy to show that a 25 in. cylinder was twice as effective a cooler as a 50 in. cylinder. Still, the action exists, and partly accounts for the fact that in engines of similar design very few cylinder troubles were experienced with engines developing about 250 b.h.p. per cylinder, whilst most serious troubles were met with when from twice to four times this power was developed per cylinder. This applies to cylinders of the earlier designs, great improvements having been effected within the last year or two. The bad effect of the metal thickness on wall temperatures is too evident to call for comment, but it should be pointed out that this thickness increases in direct proportion to the maximum pressure expected in the cylinders, and also to the diameter of the cylinder. Hence another reason why low compression pressures are being adopted, and also why makers hesitate to build cylinders as large as their shop equipment would permit.

So far we have spoken mainly of the average temperatures of the gases and walls, but the same remarks apply in most cases to the maximum temperature. An exception is, of course, that the two-cycle engine has only a slightly higher maximum temperature than a four-cycle engine. In some respects the maximum temperature is of more importance than the mean. Many of the cracks in gas engine cylinders are caused by surface heat stresses. Thus, if the mean temperature of the wall surface is 500° F., the actual value may fluctuate between, possibly, 300 and 1,000°, and the surface layer will tend to contract and expand correspondingly. The body of the metal prevents this contraction and expansion, so that tensile and compressive stresses are set up in addition to the stresses arising from gas pressure,

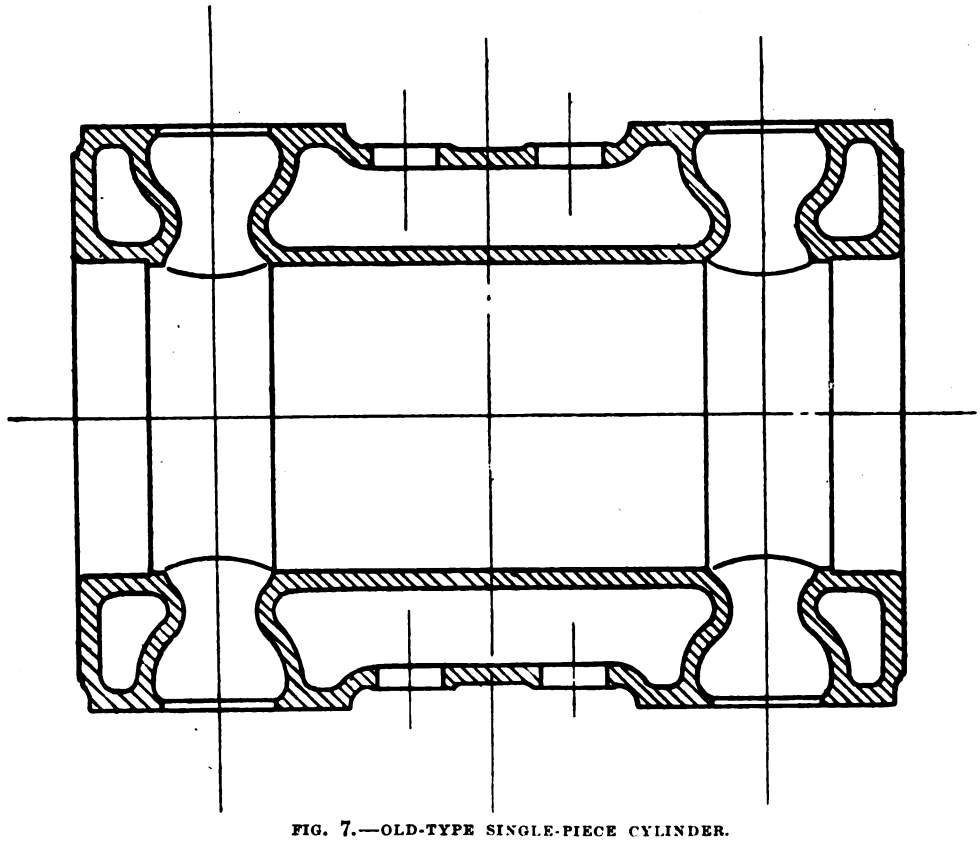

FIG. 7.—OLD-TYPE SINGLE-PIECE CYLINDER.

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casting strains, or unequal distribution of temperature between the various parts of the cylinder. These surface stresses are just equal to the stresses required to produce a degree of compression equal to the amount of the expansion prevented from taking place. Hence these stresses are directly proportional to the co-efficient of expansion (with temperature) of the metal and the modulus of elasticity. Thus, taking the hypothetical temperatures given above and ignoring changes in the modulus, etc., with temperature, the free expansion from the mean value would be about 0·003 in. per inch of length for cast iron and 0·0033 in. for cast steel. The compressive stresses produced by resisting the expansion would be about 19 tons per sq. in. for cast iron and 43 tons per sq. in. for steel. It will be seen that steel, by reason of its high modulus of elasticity, is more highly stressed than cast iron and may give inferior results, as in fact frequently happens where heat stresses are very important. It should be noted that excessive surface cooling, such as is produced in badly-designed cylinders, with scavenging sets up serious tensile stresses, which are very dangerous with cast iron. It will be seen that local surface failure of the metal may easily occur. Once failure has taken place the tensile stresses due to gas pressure enlarge the crack by tearing, so that the ultimate failure may be due to mechanical rather than thermal causes.

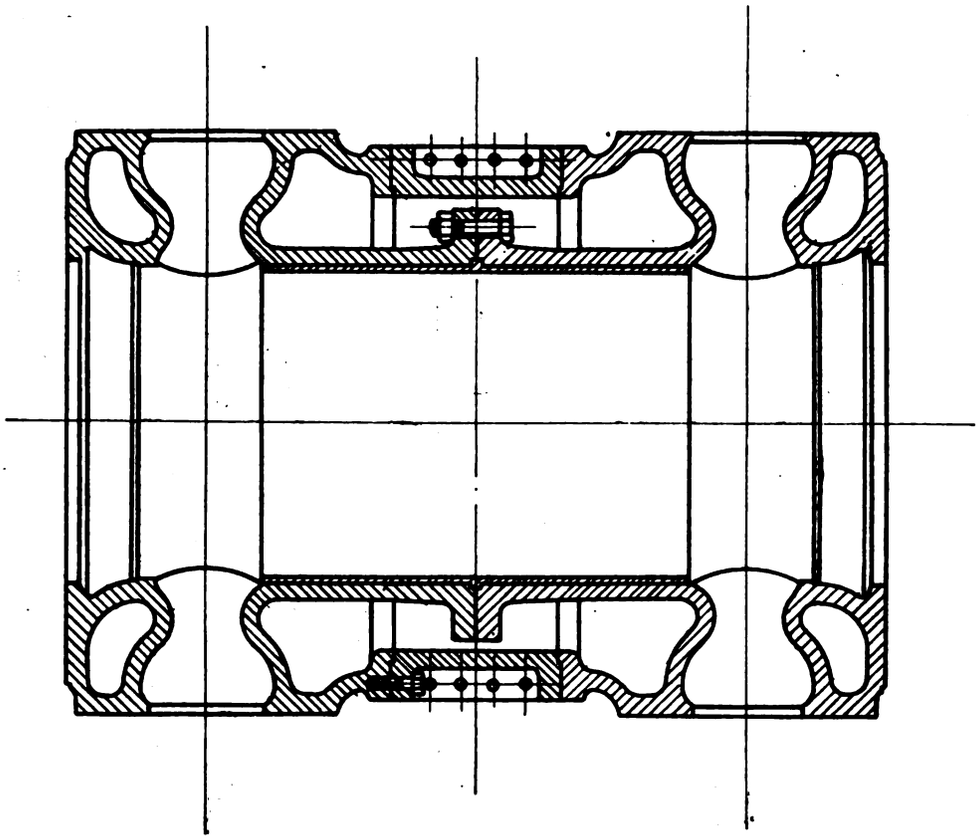

FIG. 8.—INTERMEDIATE STAGE IN EVOLUTION OF BUILT-UP CYLINDER

Leaving the subject of surface stresses and cracks, we pass to the general defects encountered in gas engine cylinders, which are all directly or indirectly due to heat. Fig. 7 shows a typical large gas engine, as formerly made by Messrs. Ehrhardt & Sehmer, of Saarbrucken, Germany. This cylinder, like a great many other continental designs, was cast in one piece. There were two concentric barrels

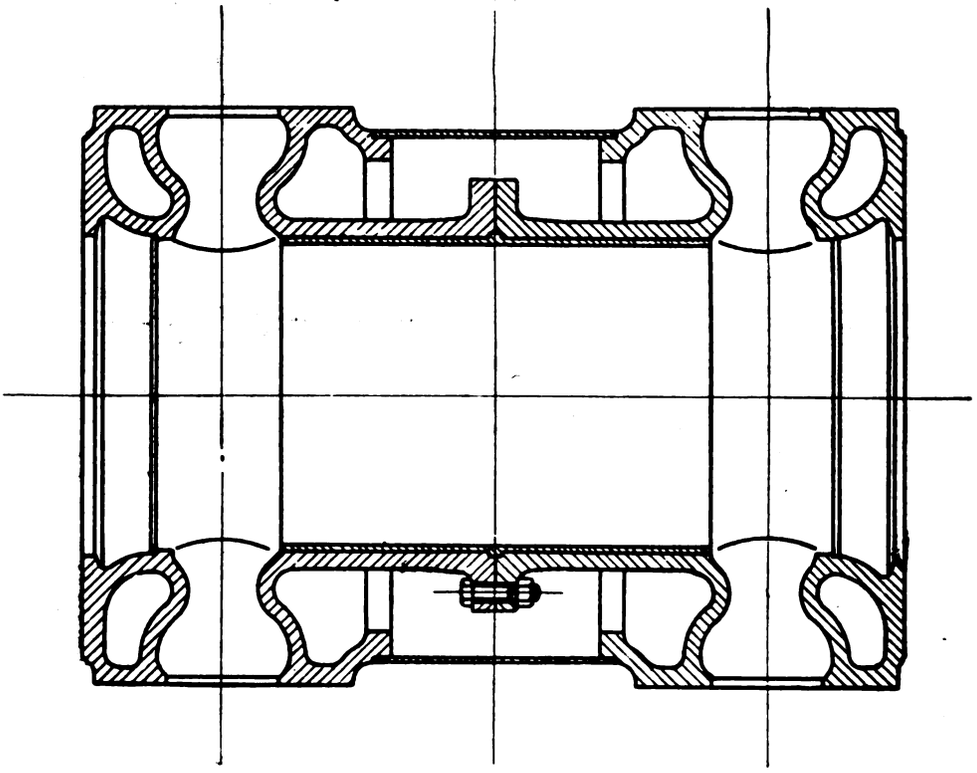

FIG. 9.—EHRHARDT AND SEHMER BUILT-UP CYLINDER.

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tied together by the two end flanges, and the neck pieces of the four main valves, the four igniters, and the four air-starting valves, not to mention any ribs there might be connecting the two barrels.

Such a cylinder has two primary defects. In the first place, the parts are too rigidly tied together to permit of the casting contracting freely in the mould when cooling. Hence such cylinders are never obtained without initial casting stresses of unknown amount. In the second place, when the cylinder is working, the outer barrel is normally cooled by the jacket water and the air, so that it practically

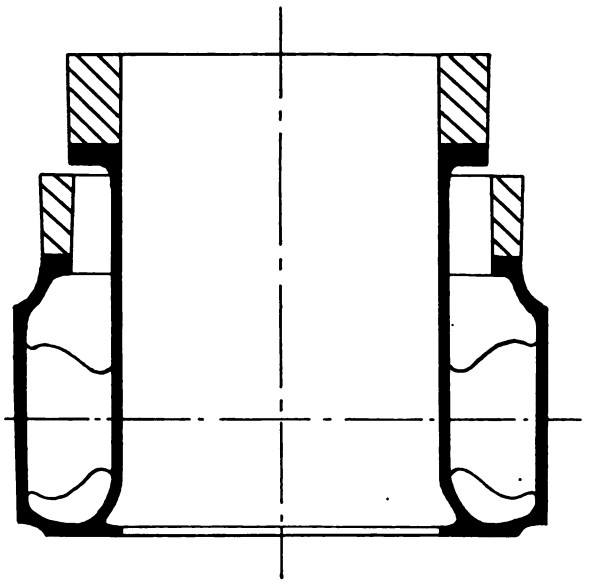

FIG. 10.—HALF OF EHRHARDT AND SEHMER CYLINDER IN MOULD.

does not expand. The inner or working barrel, on the other hand, becomes hot by contact with the gases and expands. The expansion of the inner barrel is resisted by the cold outer barrel. These two barrels pulling in opposition put the outer one into tension and the inner into compression, and tend to break off the neck pieces at the junctions with the barrels. In practice cracks are commonly started at these junctions, and after a time, in spite of ductile straps of metal riveted across the crack, the cylinder has to be renewed. In some designs this weakness is increased by omitting to bellmouth the necks at the junctions, such omission not only leading to mechanical weakness, but also, by reason of the scour against the sharp corner of metal at the junction, leading to excessive heat stresses.

The existence of these casting and heat stresses is fully recognised by makers, and much experimenting and scientific care has been expended in trying to overcome these difficulties. Apart from the choice of special foundry mixtures for the castings and the adoption of great care in the details of design and moulding, there are two ways of attacking the problem.

One, which appeals particularly to continental designers, is that of balancing the casting stresses against the expansion stresses. Stated thus simply, this method seems highly scientific and satisfactory. Looked at more closely, it bristles with difficulties, although it must be confessed that continental makers have carried it to a considerable degree of perfection. The difficulties in the way of a satisfactory result are serious, and, however skilful the designer may be, there must always be some uncertainty. Thus, initial casting stresses are uncertain in amount. By pouring the metal at one temperature and by care and uniformity in the moulding—particularly as regards the cores—so that the mould always offers the same total and local resistances to the contraction of the metal, a very great step in the direction of uniformity is made, but with the best of designs and the most rigid adherence to scientific foundry methods it still remains impossible to estimate the value of the initial casting stresses, or to maintain them at one figure in successive castings. Further, it is not possible to estimate accurately the expansion stresses. Experiments have been conducted with great care, but the results are little more than general indications of what is taking place; and in any case these stresses vary with the working conditions in the cylinder and upon the effectiveness of the jackets, both as a whole and in their sections. Hence, by this method one has to balance one unknown and variable stress by another unknown and variable stress.

The other method of attacking the problem will appeal strongly to English engineers. Instead of attempting an unsteady balance between unknowns, the unknowns are eliminated so far as possible. Thus in the Ehrhardt and Sehmer engine, as made by Messrs. Galloways, of Manchester, the casting stresses are reduced to a minimum by adopting a built-up construction, as illustrated in Fig. 9. The cylinder body is split transversely and is cast in two symmetrical halves. Each approximates to a double cylinder with a cross-section of flat **U**-shape. Obviously the **U** section permits very free contraction in the mould, and casting stresses are reduced to a minimum. In its completed form the outer barrel or jacket-casing is a rolled steel band in halves clipped into the cylinder body through rubber joint-rings. These rings form an expansion joint, so that the inner barrel is free to expand, and in practice a movement of as much as 2 mm. takes place. It is important that the jacket casing should not be bolted rigidly to the cylinder body or ends. In one of their designs intermediate between the old single-piece cylinder and the modern built-up type Messrs. Ehrhardt & Sehmer did adopt a cast-iron jacket bolted to both cylinder ends, as shown in Fig. 8. but it did not permit the cylinder body to expand, and was abandoned. Strangely enough this defective method is still in use by some makers. A somewhat similar construction to that adopted by Messrs. Ehrhardt & Sehmer is being built by some of the American firms, and evidence of the success of this method of attacking the problem is to be found in the number of makers who are trying built-up designs. One of the incidental advantages of a cylinder of the type illustrated in Fig. 9 is that should one cylinder-end crack, it is not necessary to replace the whole cylinder, but only the defective half. Before leaving this part of our subject, it may be as well to refer to the liner shown in Fig. 9. Objection has been taken to liners for gas engine cylinders on the ground that they work loose. In this case the liner is held between the two cylinder-ends by a collar and cannot work loose. This liner has two functions. It is intended to act as a wearing liner, which can be bored out when necessary, and finally renewed without replacing the cylinder body. Also it acts as a heat shield to the cylinder barrel.

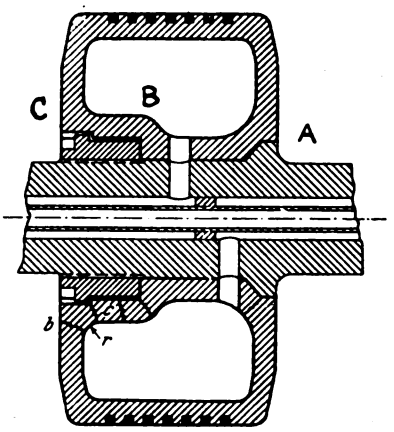

FIG. 11.—OLD-TYPE PISTON SHOWING FRACTURES.

Next to the cylinder, the piston has probably caused more trouble than any other gas engine part. In the case of double-acting engines it is absolutely necessary to water-cool the piston, and in the case of single acting engines it is desirable to do so in the larger sizes. A hot piston has several defects. It heats up the incoming charge, and reduces the weight of the charge taken in per stroke, and therefore also the maximum power which the engine will develop. Also, if there are any projections on the piston face, these may become so hot as to cause pre-ignition of the charge, which are apt to be dangerous as well as objectionable. Further, the high temperature affects the metal and promotes cracks. Even more objectionable is the fact that in order to allow for the expansion of the piston it is made a very slack fit in the cylinder. Before it has fully warmed up, it is liable to allow the hot gases to blow past it, and these very soon score the cylinder walls and establish a permanent leakiness which is bad for the engine, and renders the atmosphere of the engine room bad for men and electrical machinery.

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Water-cooled pistons have had their troubles. Fig. 11 illustrates an ordinary continental type, and which was formerly made by Messrs. Ehrhardt & Sehmer, of Saarbrücken. As in the case of cylinders, casting stresses are found in the piston, the boss or centre being in tension. When working, the outer circumference is always hotter than the boss, and its expansion tends to increase the tensile stresses in the boss. It will be seen that in order to avoid projections from the piston face the nut is let into the body of the piston and bears against a shoulder *A*, compressing the portion *A B*, and increasing the tension in *A C*. The shape of the cavity for the nut introduces sharp corners in the "flow" or direction of the metal, and these, especially in view of the tensile stresses to which the metal is subject, greatly weaken the boss, so that in practice cracks were common. To overcome these the boss was split transversely, and by suitable heat treatment the gap was enlarged and stopping rings inserted. When the piston

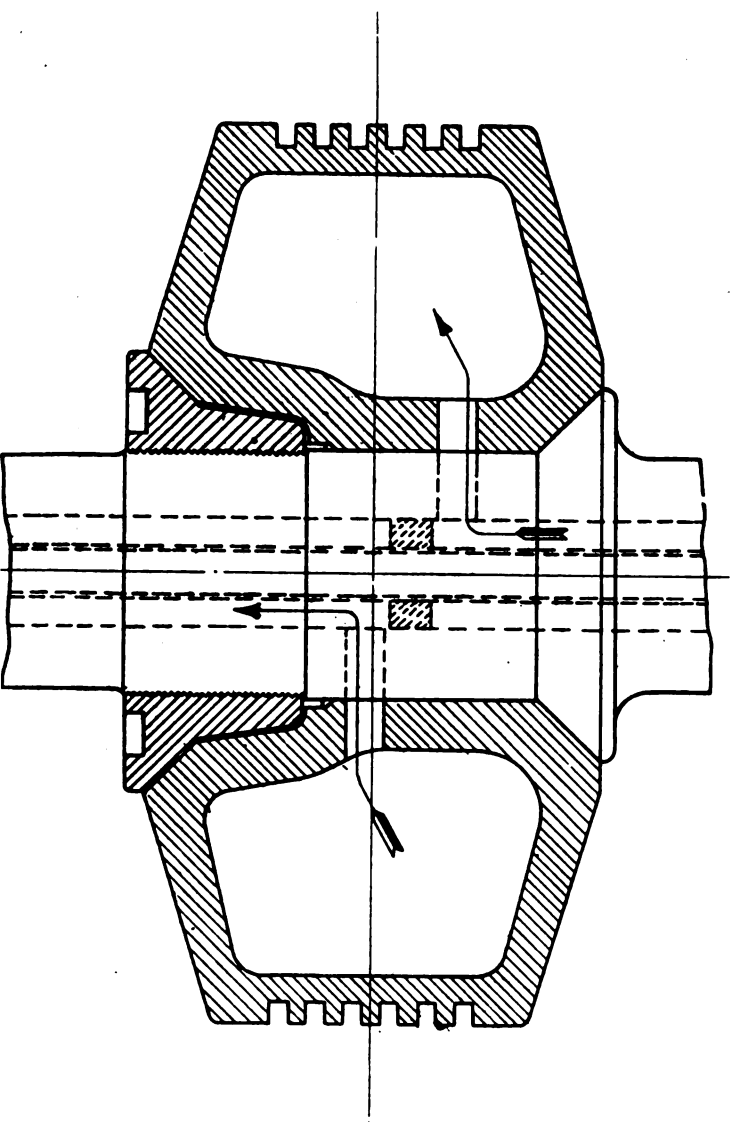

FIG. 12.—NEW EHRHARDT AND SEHMER PISTON.

cooled, the boss was put into compression by these stop-gap pieces and the weakening influence of tensile stresses avoided. Although an improvement on the older type, this piston was abandoned by Messrs. Ehrhardt & Sehmer for the one shown in Fig. 12. In this design the nut grips the piston so that the whole boss is in compression. Also, the conical shoulders on the nut and rod between which the piston is held enable sharp curves in the "flow" of the metal of the boss to be avoided. Another advantage arises from the fact that the outer circumference is narrower than the boss, and therefore its expansion affects the boss proportionately less than in the old piston. In practice this design has proved wholly satisfactory.

Some makers have endeavoured to overcome their piston troubles by adopting a built-up construction, the piston halves being bolted to a shoulder on the rod. This method enables casting stresses to be eliminated, but does not avoid expansion stresses. The cases of cylinder and piston, it must be remembered, are not strictly analogous. In the piston it is not possible to take up expansion by an expansion-joint design, and hence one great advantage of the built-up design cannot be utilised. Before leaving the subject of pistons, mention should be made of the troubles due to imperfect internal ribbing, arising mainly from spongy metal. This sponginess can be overcome by careful design, but many makers prefer to avoid ribs altogether and, instead, make their pistons very deep for strength.

Crossheads deserve a few words. Owing to the hollow rods the plain cottered joint is unsuitable. Screwed joints have disadvantages. The nuts must be a tight fit and yet capable of rapid dismantling. The ordinary right and left threaded nut or muff coupling is obviously too liable to bind fast, and in any case is cumbersome. Hence it is fairly common for makers to make this nut in halves, the lower half being bolted to the crosshead slipper. The objection to this is that since the nut must not revolve, it is difficult to ensure a rigid coupling. Otherwise it is satisfactory, and enables the crosshead and rods to be taken adrift in a very few minutes. Fig. 13 shows Ehrhardt and Sehmer's solution of the difficulty. The nuts are solid, and have grooves turned in the outer surface. These nuts are clasped by the bolted halves of the crosshead body. A part turn of either nut butts the two rods firmly together, and binds both nuts against the shoulders of the crosshead body, making a rigid self-locking coupling. Similarly, a part turn of either nut slackens the coupling, and the crosshead cap can be removed, thus freeing the rods. If the nuts will not move, the crosshead cap can still be wedged off without damage to the rods or nuts. This arrangement also permits of front and back rods being alike, thus reducing spares to a minimum.

Turning to valves and valve gears, we find that the average continental designer has allowed his love of scientific detail and geometrical accuracy to run riot when designing valve gears. The governing of a gas engine may be carried out upon three principles :—

(1) By the hit-and-miss method ;
(2) By varying the quantity of gas and air admitted (quantity governing) ;
(3) By varying the gas supply only (quality governing).

The first method is not used on large engines. Each of the other two can be effected in many different ways, and as each has its own advantages, real or supposed, both methods may be combined. Further, the advocates of the stratification theory argue that by admitting the gas last thing during the suction stroke, a strong charge is obtained in the neighbourhood of the igniters even at light loads and with quality governing. Whatever may be true of small cylinders, it is very doubtful if effective stratification can be obtained in large ones. However, it is not proposed here to discuss the many governing problems of gas engines, but only to point out the many opportunities which they afford for complex valve gears. According to the reports of Mr. Michael Longridge, about one-third of the gas engine breakdowns coming under his observation arise out of defective valve gears. Hence the importance of simplifying these gears. This has been recognised by several makers in the United States, but most of the continental makers still cling to their elaborate designs. An exception is the firm of Ehrhardt & Sehmer, who have recently introduced the gear shown in Fig. 14. Plain throttle governing is adopted. The gas valve is under the control of the governor, and for certain classes of loads the governor is also coupled to a throttle valve on the air inlet pipe. In order to enable the strength of the mixture to be altered when starting the engine and when the quality of the gas is altered, a hand-regulated throttle valve is placed on the air pipe. This gear gives excellent results, both as regards operation and economy. Apart from the gear the valves themselves are noteworthy. The gas valve is mounted on the same spindle with the main inlet valve, but in order to ensure both valves closing tight when their seats are unequally worn, the gas valve is spring mounted. By thus ensuring tight valves, leakage of gas and the consequent wastage and risk of backfiring are avoided.

Some brief mention of water cooling is desirable. In the case of cylinders, pistons, and covers, especially, it is of the highest importance that the cooling should be effective. This implies that the water spaces must be kept free of

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scale and sediment and also of air bubbles. One great advantage of the built-up cylinder is the facility it offers for inspecting and cleaning the jackets. This is a matter which has not received sufficient attention in the past; although it is safe to say that a very large proportion of cylinder breakages has arisen from or been accelerated by dirty jackets. As regards the parts to be water cooled there is little dispute except as regards the exhaust valve. Some years ago Messrs. Ehrhardt & Sehmer gave up cooling their exhaust valves as unnecessary, and they have never had any trouble on this account. On the other hand, many writers have urged that effective cooling of the exhaust valves is of vital importance. The truth seems to be that it is quite unnecessary, but that if it is done it must be skilfully done.

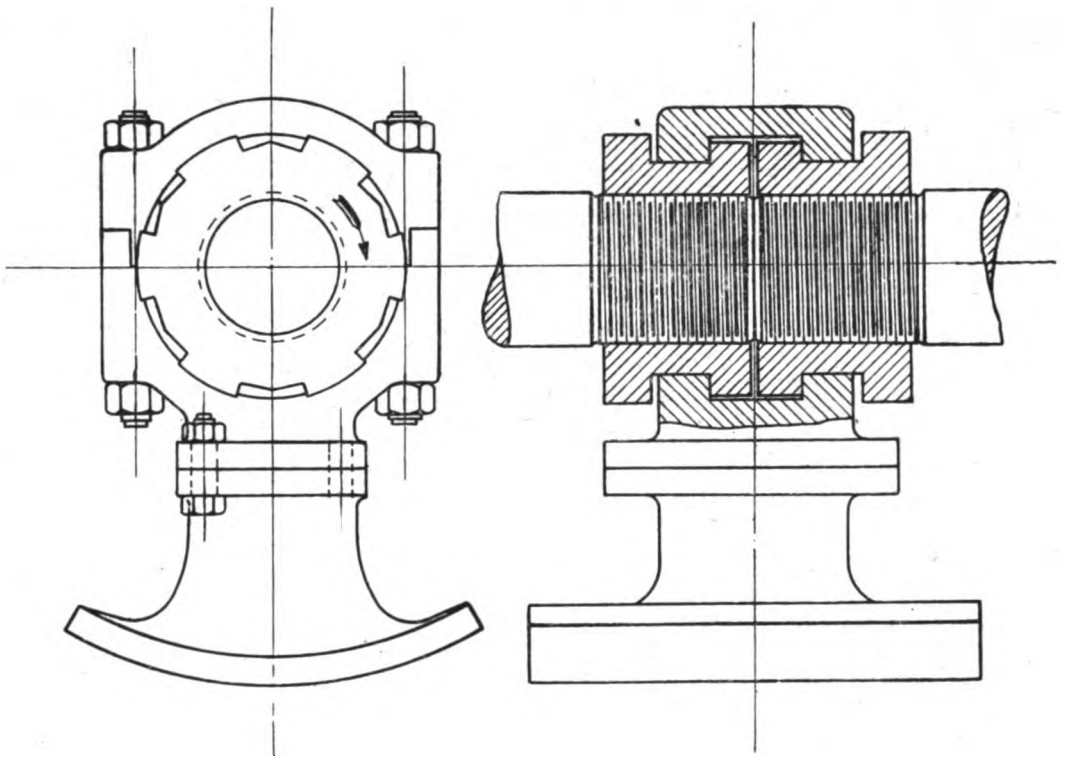

FIG. 13.—EHRHARDT AND SEHMER CROSSHEAD.

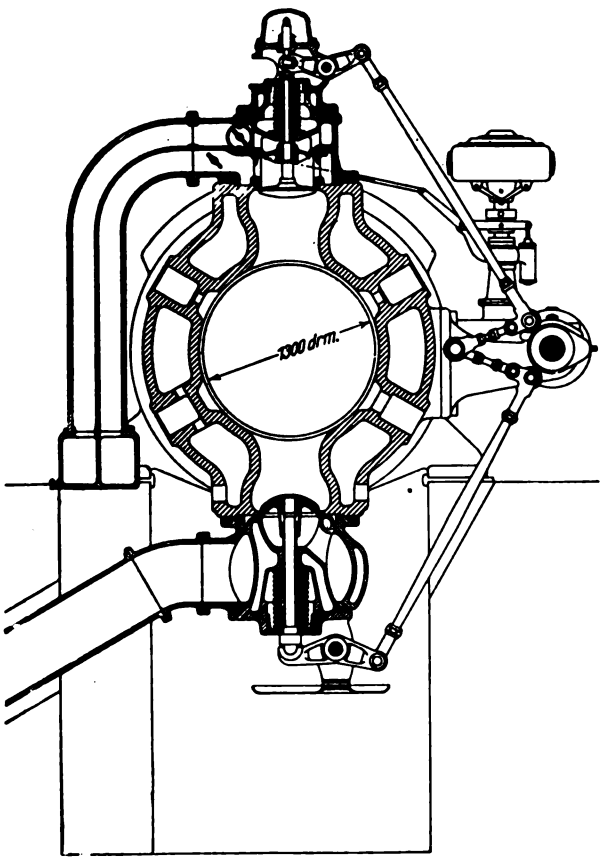

FIG. 14.—EHRHARDT AND SEHMER. VALVE GEAR.

Gas engine frames have given a good deal of trouble to their designers, more probably, than can strictly be accounted for from a simple consideration of the static loads due to gas pressures and inertia. Whether or not this is due to the shock nature of the load is open to question, but one way in which some designers aggravate their difficulties is represented in Fig. 15. It will be seen that the walls of the frame are offset to give width to the pedestal jaws. These offsets involve a sharp change in the flow of the metal along which the principal stresses are transmitted. This corner introduces casting weakness and weakness under stress. Hence such frames frequently fracture at *A* and *B*; even before they get out of the shop in some cases. The remedy for this class of weakness is obvious; and, indeed, the weakness itself is obvious.

There is one other serious trouble which all makers of large gas engines have to face. Gas engines are more expensive than steam. Under very favourable conditions the difference in cost between a gas plant and a steam plant may be reduced to a small amount, perhaps 5 or 10%; but five times this is more usual. Unfortunately, some enthusiasts have used the exceptionally favourable instances to demonstrate that gas plants really do not cost much more than steam, with the result that customers imagine they are being bled when they purchase a gas plant, and prices have been forced down to an unremunerative level. The gas engine is a great saver of fuel, and customers ought to be only too pleased to pay the extra cost of one.

As there seems to be an impression that the high prices of gas engines are artificial, it may be as well to point out the physical basis upon which they rest. In a standard compound steam engine, the maximum steam pressure in the high-pressure cylinder will be 155 lbs. per sq. in. and 20 lbs. to 30 lbs. in the low-pressure. The maximum effective pressures will be 140 lbs. and 35 lbs., whilst the mean effective pressures will be about 64 lbs. and 16 lbs. Thus the ratio of maximum effective to average is 2·2 for each cylinder. In a gas engine the maximum pressure may be 350 lbs., and in some cases as high as 500 lbs. has been registered. The mean effective pressure is only 30 lbs. to 32 lbs., so that the ratio of maximum (assumed at 350 lbs.) to mean is about 11 lbs., or five times that of the steam engine; and, of course, the parts have to be strong enough to withstand the maximum pressure. By putting two cylinders in tandem the connecting rod, main frame, and crank shaft are not subjected to any higher stresses, but the intermediate frame, back piston rod, cylinder barrels, and valve gear remain as before. Hence, even in this case, the ratio of maximum to average pressure for the whole

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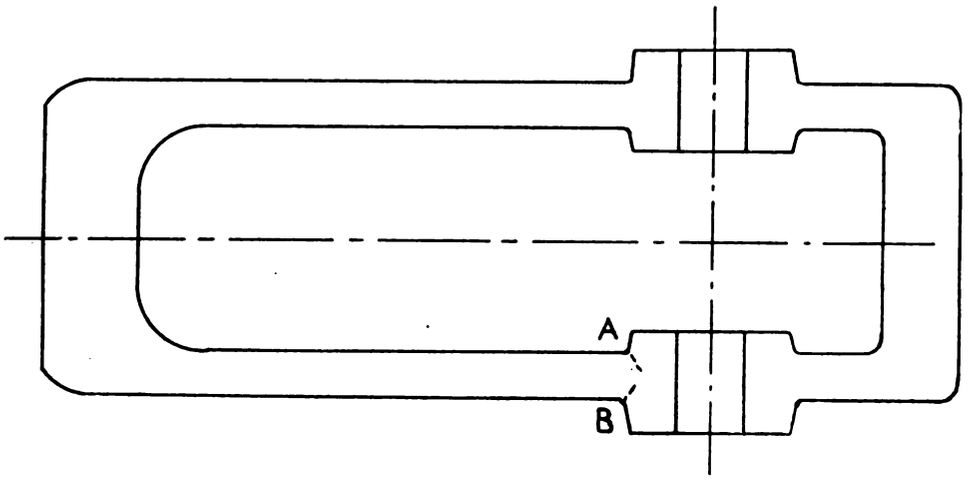

FIG. 15.—DEFECTIVE FRAME.

engine is nearly 4 lbs., as against 2·2 lbs., for the steam engine. Further, the severe conditions under which the gas engine works necessitates more expensive materials than in the case of steam engines. The wonder is that gas engines are as cheap as they are.

SIR CLIFTON ROBINSON.

We regret to have to record the death of Sir Clifton Robinson, which occurred with tragic suddenness at New York on Monday. Sir Clifton, who commenced his career in tramway affairs, practically ended his life in a tramway car, for he was returning to his hotel with Lady Robinson in a tramcar, when he was suddenly seized with an attack, and, being removed to a druggist's store, expired therein from apoplexy. Although he had virtually retired from tramway work in England, he was still actively engaged in carrying on his enterprises abroad, where, as he told us only a short time ago, he expected to find ample room for his energies. Sir Clifton Robinson played a big and useful part in popularising tramways over here, and both the electrical industry and the public at large owed him much. He was a hard worker, a keen man of business, but one of exceptionally kindly nature, generally looking upon the bright side of things, and while sternly fighting against opposition, taking such opposition, and even defeat, without ill-feeling. Sir Clifton Robinson was born in 1848, at Birkenhead, where he opened the first public tramway to be laid down in England. He went to America with Train, and at Los Angeles, California, he constructed the first system of cable and electric tramways, and then came to London, where he designed and constructed the London United Electric Tramways system, and in 1895 gave Bristol its first electric tramway. As managing director and engineer of the Imperial Tramways Company, he had control of the work of constructing and reorganising the Dublin Southern District Electric Tramways in 1896, and the Middlesbrough, Stockton, and Thornaby Electric Tramways in 1898. As our readers know, he was largely concerned in the promotion of the London tube railway system, and was responsible for the system of through bookings between the tramways and railways which have been so largely used.

ELECTRICITY IN MINES.

At the quarterly meeting of the Federated Board of Miners, Enginemen, and Firemen of Derbyshire and Nottinghamshire, which was held on Saturday at Chesterfield, the precautions necessary owing to the introduction of electric motors in mines came up for discussion. Mr. James Martin (President of the Derbyshire Miners' Association) occupied the chair, and there were also present Messrs. James Haslam, M.P., W. E. Hardy, M.P., W. Carter, B. Kenyon, F. Hall, W. Sewell, W. Walker, H. Godber, and C. Bunfield (representing the Miners' Associations of Derbyshire and Notts), and J. F. Fearn, T. Armstrong, S. W. Rowarth, S. Fox, W. Fletcher, J. Tagg, W. E. Walker, and Joseph Shelton (representing the Derbyshire and Notts Enginemen and Firemen's Union).

One of the questions discussed had reference to inexperienced persons being in charge of motors down the pits, and it was alleged that at some collieries boys, who had no practical knowledge of it, were using this electrical energy. Several cases were cited where the fusing of the wires had proved a source of danger to the men in the mine, and a case was instanced where two lives had been lost.

Several of the speakers took exception to its being used in the mines at all.

Mr. Haslam remarked that it was not so much the introduction of this machinery into the mine to which they took exception, but the danger arising from inexperienced persons being put in charge; he had no doubt there would be less accidents if only experienced persons were allowed to be in charge.

Mr. Harvey was of the same opinion, but was afraid that cheapness had something to do with it at some collieries. Human life, however, must not be sacrificed on the altar of cheapness.

Mr. S. W. Rowarth said that a good few of the members of the Derbyshire and Notts Union had been displaced, and that boys were now manipulating the motor, where hauling enginemen used to be employed.

Eventually the following resolution was passed:—

"That this joint Board of the Enginemen and Firemen's Union and the Derbyshire and Notts Miners' Associations having considered the danger attached to the introduction of electricity in mines and the appointment of inefficient men to drive these electric motors, protest against a continuance of these dangers, and pledge ourselves to use our best endeavours to obtain in the new Miners' Act safeguard against the danger described in this resolution."

Consequent upon Mr. W. A. Turnbull leaving York for Stoke-on-Trent, Mr. Nicholas, Mains Superintendent, has been appointed Chief Assistant to the York Corporation Electricity and Tramways Department, at a salary of £150 per annum, rising to a maximum of £170 by increments of £10; and Mr. Holmes, Charge Engineer, as Works Superintendent at the Electricity Works at the salary of £130, rising to a maximum of £150 by increments of £10.

As the result of Mr. P. J. Pringle leaving to take up an appointment in Australia, the Burton-on-Trent Corporation have decided that electricity works and tramways should be under separate control for a period of six months, as a trial. Mr. Hall takes charge of the electricity works, and Mr. Slater of the Tramways Department.

Mr. McNamara, electrical engineer to the Corporation of Limerick, having resigned in deference to the wishes of the Town Council, three months' salary and such bonus as they could legally award, was voted in lieu of notice.

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Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

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EDUCATIONAL PROBLEMS.

One of the most hopeful auguries for the future welfare of the nation is the spirit of unrest so sharply manifested with regard to our present methods of education. The discontent with things as they are has been specially conspicuous in connection with the electrical industry for some time past. Last autumn on the opening of the new University and Learned Society Sessions there was plenty of criticism, and the same thing is again observable this year, though perhaps in a more outspoken and direct form. Last week we gave some notes on Mr. J. S. Peck's address before the Manchester Section of the Institution of Electrical Engineers. A few days later Mr. C. Faraday Proctor was opening the new session of the Newcastle Section, and he took for his topic, "Practical Education." He, like Mr. Peck, contrasted our own methods with those of France and Germany, and the results obtained therefrom. Now, from actual experience in organising industrial undertakings at home and abroad, Mr. Proctor gives it as his deliberate opinion that the foreign worker starts with a better elementary education than does the Britisher of the same class. The foreigner, consequently, can keep books, can follow out an argument, is neater and more methodical and sees further ahead in industrial or mechanical problems. The complaint seems to be that our educational methods are directed too much to the teaching of special matters, rather than training, and that the anxiety to teach subjects, rather than to train the mind, eye, and hand, with the correlated desire to pass examinations, leads to superficiality. Mr. Proctor has nothing fundamental to say against the British workman, who, properly trained, can hold his own against any comer. The trouble is that the proper training is absent. In the early stages of education we want teaching on broad lines, training the mind to think systematically, to grasp problems

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as a whole, while dealing with details; and secondly we stand in need of more practical training. Too often both men in responsible positions and artisans take a narrow view of their work, and consequently they are handicapped owing to their having no clear conception of a problem as a whole. They are content to do one thing well, according to their lights, but if they grasped the ultimate object of their labours they might often see ways of improving or simplifying their methods. Men in higher positions also take narrow views, are engrossed with chemistry or mathematics, and for want of being in touch with the practical side the problems as a whole, often do not work to the best advantage. The French and Germans, says Mr. Proctor, treat the clear understanding of a problem as a matter of paramount importance. Consequently they frequently show greater logic in carrying out the details of manufacture, with the result that greater accuracy is secured. We have the men: it is a question of equipping them so that they may make full use of their abilities. Our present methods scarcely do that, and so we find many of those responsible for the organisation of our industries calling for an overhauling of our educational system and bringing more practical methods to bear.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the apparance of the questions.

QUESTIONS.

Question No. 1235.—State the main points to be taken care of in laying out hydro-electric schemes. When is it necessary and when economical to instal auxiliary steam plant? What considerations govern the choice of towers, the permissible line drop and the working frequency? What is current voltage practice in such schemes and how may voltage be raised later on if desired? How are the sub-station positions and ratios of transformation determined?—"HYDRO."

ANSWERS.

Question No. 1230.—In designing starting resistance for three-phase induction motors, the rotor volts at starting and rotor current per phase are usually given by the makers. It is found that calculations based on these two figures only, give too high a value for the starting resistance. Having given only the above two figures, show how the starting resistance for starting under, say, normal full load or twice full load can be obtained. Note that in general it is not possible to get the resistance of the rotor per phase from the makers.

Answer to Question No. 1230 (*awarded* 10*s.*).—Given only the rotor volts at starting and the normal rotor current per phase, we have that a known rotor voltage has to force a known current (at full supply frequency, momentarily) through the ohmic resistance of the rotor and starting resistance and through the reactive impedance of the rotor. These two components of the total impedance are perpendicular in phase and are respectively $(r+s)$ ohms and $(f \times \sim')$ henries (where r = rotor resistance per phase and s = starting resistance per phase and f = a constant for each machine). Neither the ohmic nor the reactive components can ordinarily be calculated from the data supplied by the makers, but the ohmic resistance per phase of "wound" rotors can be measured fairly easily and the constant f can be eliminated as follows:—

I. Suppose that the rotor resistance per phase (measured or determined from a Heyland circle diagram for the machine) = r ohms and let

s = required starting resistance per phase.
A = full load rotor amps. per phase (given)
$\sim'$ = frequency of supply
$\sim$ = frequency of slip (= say 5% of $\sim'$)
$\sim''$ = $(\sim' - \sim)$.

Then rotor volts at starting equal the *resultant* of A $(r+s)$ (ohmic drop) and F.A. $\sim'$ (reactive drop). (Note that if r and f be known or determinable, s at once follows for the rotor volts at starting is given by the makers.)

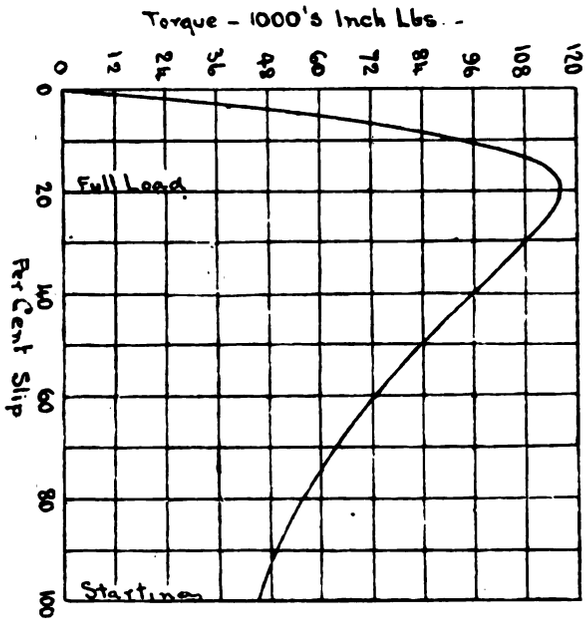
Again, rotor volts on full load equal the *resultant* of A.r (ohmic volts) and F.A. $(\sim)$ (reactive volts).

And, since the ohmic and reactive volts retain throughout practically a constant ratio to each other, we have:—

$$\frac{A\,(r+s)}{A.\,r} = \frac{F.A.\ \sim'}{F.A.\ \sim}$$

$$\text{whence } S = r\left(\frac{\sim'}{\sim} - 1\right) \quad \ldots\ldots \quad (1)$$

which, for 5% full load slip, gives the starting resistance $S = 19 \times$ the rotor resistance (per phase in each case). The starting torque will then equal the full load torque of the motor: in many cases this is unnecessarily high and s is then increased to 30 or 40 times r. In all except the smallest machines it is usual to make the starting current of induction motors somewhere between full load current and ½ the latter—(s consequently lying between 20 and 35 or 40 $\times$ r).



II. Rather a different method of solving the problem, and one which is applicable only when certain features of design of the motor (*e.g.*, leakage coefficient σ, rotor flux density B_R and so on) are known, is as follows:

$$C_R R_R = \tfrac{1.1}{9} \times \sim \times T \times B_R \times b \times N_R \times p \times 10^{-8} \quad . \quad (2)$$

where T_R = rotor current (full load) : R_R = rotor resistance
C = pole pitch (rotor) : b = axial length rotor iron
N_R = conductors per pole per phase on rotor
p = No. of stator poles.— : $\sim$ = $(\sim' - \sim'')$
and $B_R = (1 - \sigma) \times B_{stator}$ ($= 0{\cdot}95\ B_{stator}$ say)

The rotor resistance per phase is thus calculable.

On starting, however, $\sim$ is momentarily = $\sim'$ and, assuming the rotor current to equal its normal full load value, the resistance of (rotor + starter) = $\frac{\sim'}{\sim} \times R_R$ (= 20 R_R if normal slip = 5%) so that, as before, under these conditions the starting resistance = 19 $\times$ R_R.—

Under more general conditions:—

$$\text{The Starter resistance} = K \times \frac{B'_R}{B_R} \times \text{rotor resistance}$$

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where B'_R = rotor flux density under starting conditions
B_R = rotor flux density under normal full load
and K = values shown in Table I.

TABLE I.

Starting Ct.	Values of K for Slip (%) =					
Full Load Ct.	2	3	4	5	6	7
0·4	124·0	82·5	61·5	49·0	40·6	34·7
0·6	82·5	54·8	40·7	32·3	26·8	22·8
0·8	61·5	40·6	30·3	24·0	19·8	16·8
1·0	49·0	32·3	24·0	19·0	15·7	13·3
1·3	37·5	24·7	18·2	14·4	11·8	10·0
1·6	30·3	19·8	14·6	11·5	9·4	7·9
2·0	24·0	15·7	11·5	9·0	7·3	6·2

The ratio $\frac{B'_R}{B_R} = 1$ when starting with normal full load current.

The starting torque $= \frac{C'_R B'_R}{C_R B_R} \times$ normal full load torque (3)

III. Yet another method of procedure is to determine a suitable starting resistance by trial, commencing with one which is obviously too great and cutting this down till a satisfactory performance is achieved. The motor should meanwhile be protected by suitable fuses, or cut-outs, and an ammeter should be placed in the stator and rotor circuits.

If the torque-slip curve (Fig. 1) of the motor can be conveniently determined (either when running the machine as a squirrel-cage motor or when starting with a certain known external resistance in the rotor circuit) then, by arbitrarily varying the total rotor circuit resistance and observing the altered starting torque, the value of the rotor resistance can be deduced (using Fig. 1) and the starting resistance at once adjusted to give the desired starting torque.

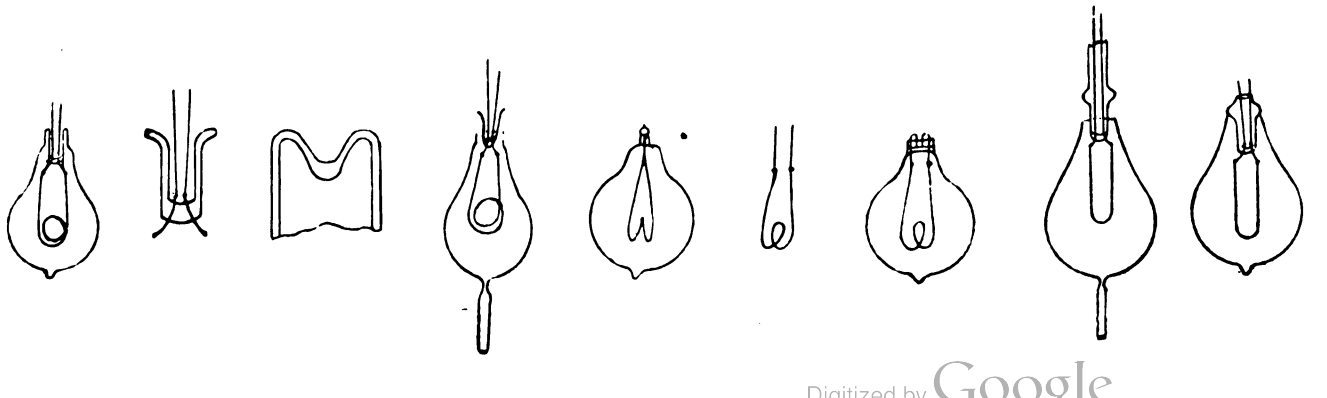
IV. Finally it may be pointed out that, if the makers have not supplied a suitable starting resistance (a peculiar omission since the motor is practically useless without it), they can probably at once supply a suitable apparatus *or* inform "E.J." of the requisite resistance per phase to give any desired starting torque, *or*, at least, they have all the data in their design-office records to enable them to determine the starter required for any particular circumstances, however unusual.—"CITY."

THE INCANDESCENT LAMP.

An Example of Practical Thought.

Mr. C. Faraday Proctor, in the course of his able presidential address to the Newcastle Section of the Institution of Electrical Engineers on practical education, drew attention to the necessity of disciplining one's thoughts. People are apt to think spasmodically, to look at a question from too narrow a point of view. In engineering, as in most other things, a problem cannot be solved to the best advantage unless final results are understood and kept in view.

Mr. Proctor said:—I think from a theoretical point of view, education must consist of two primary processes namely, the impressing on the brain, a picture, and secondly, the cultivation of the brain in such a way as to enable it to readily receive the pictures and to be able to call them to mind at will, and profitable education must consist of the opportunities given to the brain of obtaining records, and the choice and permanency of the records obtained, but supposing we have a large collection of good records, they are of little use unless they can be called to the front at appropriate moments and even then it requires another, and, I think, a still greater faculty, namely, that of seeing how to fit in the various somewhat similar pictures or impressions in such a way as to make them of use when new conditions occur, and so enable the brain to form a new picture, and continually drawing from its stock of records until what is called a completely new idea has been developed. Let me take, for example, the present method of making an incandescent lamp. Every engineer knows that sharp corners should be avoided, especially when large differences in temperature occur, such as in castings, and the same also applies to glass work. In the Edison design, Figure 1, and the Swan, Figure 2, the leading-in wires are both secured in the glass by pinching in while hot on to the wires. In the Swan lamp this process completed the lamp, but left the most fragile part of the lamp subject to the whole strain of the brass collar. In the Edison the pinched joint was much more easily made, being made before the filament was attached, but the serious complications of joining the bulb formed on the tube-like stem to the neck of the lamp bulb, rendered this form of construction much more expensive than the Swan, and also very liable to crack at the joint; but, on the other hand, the Edison design has the great advantage that only short pieces of platinum can be used, and when in 1886 to 1890 platinum rose to more than three times its original value, and the necessity of designing a lamp end which gave a better hold for the lamp cap, was also becoming a serious matter, I felt that a lamp having an internal tube like the Edison, but a strongly shaped seal, must be found. While in a restaurant I was impressed with the great strength and simplicity of the shape of recessed or hollow-bottomed common bottles, and succeeded in combining that idea with the tubular support that I wanted for my lamp, and after various other stages, arrived at the funnel-shaped glass stem as used at present. Now, what I want to draw special attention to is the system that the brain has of adapting the various pictures or parts of them, one to another, until the idea is complete, and I contend that the overcrowding of the brain with records, seems to crowd out the faculty of putting together the various ideas, or maybe the impression gets so permanent a set, that it can only see the thing exactly as it was, and I think to some extent this can be taken as an explanation why some inventors or originators are bad spellers, for they only have a general idea how the word is written, whereas the brain that cannot see another way of spelling is (shall I say for my own sake ?) wanting in originality. Of course, there must be a proper balance of ideas or, I might say, intensity of the pictures, and I believe to a great extent the rapid progress that other nations have made as compared with ourselves is owing to a better view of the ultimate object.



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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Tyneside is still suffering under the nightmare of the boilermakers' lockout. It may seem to persons unacquainted with the local conditions, that, with only that section of the membership of the Boilermakers' Society locked out which is actually employed in shipbuilding, the stoppage of work on Tyneside should not be so complete. It is true that there are engineering works and electrical factories of no mean importance in the area which are still working, but the crippling effect of the loss of the staple industry, and the dislocation of work which it is inducing, is a factor beside which all others sink into insignificance. To cheer up our spirits in this gloomy atmosphere, we have the rumour that the Amalgamated Society of Engineers is putting its back up against the premium bonus system, and that votes are being taken in the society branches as to its continuance or otherwise. If the majority is against the bonus system, as seems likely, we shall probably have another pretty quarrel on Tyneside, as this system is, I understand, in vogue in several of the big engineering establishments here.

Ship Making and Breaking.

From the local press one may gather a very good hint as to the extent that Tyneside depends upon a long-suffering and ratepaying public. If it were not for the fact that the Admiralty was resolved to keep right to the front with its naval equipment and to scrap all vessels which are obsolete or even obsolescent, H.M.S. Barfleur would not at the present date be moored at the ship-breaking yards of Messrs. Bolekow, Vaughan & Company, Ltd., curiously enough situated just opposite to the birthplace of many a battleship at Elswick. Of course, there will have to be another Barfleur to keep the historic name on the list of our warships, so that Messrs. Armstrong, Whitworth & Company are doubtless justified in making all speed in removing mountains and casting them into the sea, as they are doing at Walker in order to start their new shipyard. May the electrical equipment of that yard be shortly in the market!

Railway Extension.

It was announced during the past week at the Northumberland County Council that a new railway is proposed, running from Monkseaton, the furthest section of the electrified loop from Newcastle, to Blyth, tapping Holywell Dene and Seaton Sluice. This announcement may be taken in conjunction with the notices which have previously appeared in this column regarding the development of Blyth, which is now proceeding at a very rapid rate. It is probable that this new coast route will materially assist this development and will open up a new section of suitable industrial locations for manufacturers. It is not yet announced whether electricity will be utilised on the new section, but it is a significant fact that both at Monkseaton, the start, and Blyth, the terminus, of the proposed new line, there are important transformer sub-stations connected to the high tension transmission system of the Newcastle-upon-Tyne Electric Supply Company, Ltd.

Technical College, Sunderland.

It is announced that in consequence of the appointment of Mr. C. A. King, of the Sunderland Technical College, to the assistant professorship in engineering at the Heriot Watt College, Edinburgh, Mr. A. D. Alexander, of Dumbarton, has been appointed chief assistant in the engineering department at Sunderland. Mr. Alexander is a Whitworth scholar and an Associate of the Royal College of Science.

Messrs. J. H. Holmes & Company.

In addition to the Holmes-Alderson patent safety cut-out for fire damp in mines, to which I made reference a week or two ago, Messrs. J. H. Holmes & Company are at present paying special attention to the design of switchgear for mining purposes. They have a very interesting form of mining panel of the ironclad box type, the distinguishing feature of which is its more than usually foot-proof features. In some of the interlocked devices on the market it is possible for the determined person to operate the isolating switches with the cover of the panel open, with disastrous results. In the Holmes pattern, however, it appears to be impossible to do this, as the handle of the isolating switch is automatically removed by the opening of the door, which, in conjunction with interlocking, appears to answer the purpose. I also understand that some alternate current motor starters of this firm have some special features whereby the starting current of a motor may be satisfactorily dealt with without increasing to a dangerous limit the normal current-carrying capacity of the trip gear

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THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

All the principal electrical engineering firms in this district report that they are still exceedingly busy. In Birmingham, much interest has been excited among the manufacturing community by the exhibition of power appliances organized by the Corporation Electricity Department at the Head Offices in Dale End. Since the exhibition opened on November 1, the visitors have averaged in number about 70 per day. The commercial results to the department have exceeded expectations, a large number of new connections having been ordered and a number of promising enquiries received as the outcome of these visits. To the permanent collection in the showroom, which has already been described, a number of temporary additions have been made. These include a great variety of power and control apparatus, and are so numerous that the entrance hall has had to be utilized to enable them all to be exhibited. Among the special exhibits a few may be noted. There is a "fool proof" triple-pole switch by the General Electric Company, so arranged that the cover cannot be raised while the current is on, and the current cannot be put on while the cover is off. The collection embraces a large variety of switches, circuit breakers and measuring instruments. Photographs have been added to illustrate every form of drive, belt drive, gear drive, chain drive, direct coupled and self-contained. The photographs are all taken from installations in connection with the city supply. Among the productions of the Electrical Ordnance Company on view are a small sirocco fan driven by an E.O. motor, and a new form of control pillar for regulating the speed of 20 h.p. motors. A 30 h.p. motor and starter illustrating the saving of space as compared with a gas engine of the same capacity. Two interesting starters by George Ellison, of Birmingham, are exhibited, one an oil-immersed three-phase rotary starter mechanically interlocked with a stator oil switch or circuit breaker: the other a totally enclosed, no voltage and overload release starter for slip-ring type two or three-phase motors, with contacts for stator and rotor circuits. Messrs. W. Canning & Company exhibit one of the plating sets which are their speciality, this example giving 250 amps., 6 volts on the secondary. The permanent demonstration collection has been increased by the installation of a control pillar and starter by the Electric Ordnance Company, fitted with ammeter and overload and "no voltage" releaser.

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Electricity and Plant Growth.

The subject of the influence of electricity upon plant growth is to be dealt with by Sir Oliver Lodge at the Birmingham and Midland Institute lecture on Monday evening next. Sir Oliver has taken considerable interest in the experiments that have been going on at Salford Priors, near Evesham, and in other parts of the country, some of the varying results of which have already been recorded in the papers. A son of Sir Oliver Lodge is also taking part in the investigation, and no doubt Sir Oliver will be able to give the members of the Midland Institute on Monday a great deal of new information upon the subject.

Malvern and Electricity.

Malvern seems to be gradually waking up to the importance of providing its visitors with fresh attractions and better accommodation. Recent returns of the local authorities show that while there has been a decrease in the consumption of gas, that of electricity is going up. Another point which is occupying the attention of the District Council is the provision of improved traffic facilities. No doubt, when the proposed funicular railway is established, there will be a large influx of visitors of the class for whom cheap transit is required. This necessity has been realized already to some extent, though, apparently, with some reluctance. About two years ago a company applied for sanction to a tramway scheme linking up the three Malverns and other contiguous districts, but the application was not entertained. A service of motor-cars was instituted, but this has not proved adequate to their requirements. The District Council has now appointed a committee to consider the best means of providing a service of cars with four penny stages, and though the possibility of a motor service is still entertained, there is a growing feeling that the required provision can only be satisfactorily made by a system of electric tramways.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

The Engineering and Machinery Exhibition, 1910, is over. On all hands it is declared to have been a huge success, both as regards its organisation and the results. Many firms have obtained orders already as a direct result of their being at the show, while all without exception have largely increased their mailing lists and expect to derive considerable benefit thereby in the near future. Altogether, the show will have a very helpful effect on business during the next few months.

Educational Value of Exhibitions.

A little incident which occurred during the closing days of the exhibition illustrates another side of trade shows. One of the firms exhibiting, having acquired a reputation for a certain class of work, as the result of considerable experimenting, have recently been leaving their rivals far behind. The other day two men were observed sketching parts of the machinery in question, and on several other days they were seen lurking round the stand. The climax was reached, however, when, having waited for the exhibitor to go to the club for tea, one of them fished out a spanner from the back of the stand, and after taking out one or two bolts, climbed to the top of the stand to take measurements. On the exhibitors being informed and hurrying down, the "thieves" decamped. The men are believed to be in the employ of a rival firm and I understand inquiries are being made with a view to exposing the dishonourable methods adopted to copy a design. Brain-picking has been very common among English firms, but it is very rarely that such Sikesian methods as the above are adopted, and if in the present case they were employed with the connivance of the firm, then the sooner that firm is driven out of business the better for all concerned. It clearly has not sufficient technical ability to design the apparatus it professes to specialise in, or it would not find it necessary to stoop to what is nothing more than a very cheap form of thieving.

Current Items.

More than one local electrical firm is extending its business capacity, in the hope of getting more trade. There are signs that at last it is beginning to dawn upon the directors of at least one electrical firm, that the American method of running a business on an elaborate "series" system of organisation, highly efficient—like a steam turbine—between very narrow limits about its rated point, but decidedly inefficient for any other conditions, is not ideal, and they appear to be now going in for a sort of "parallel" self-contained departmental system, equivalent to a number of separate small firms having a common head. One firm in particular has been very busy lately floating small companies, each to take over and run a department of the old business. Further developments are about to take place in this area.

The Students' Section.

The local Students' Institution of Electrical Engineers opened their 1910–11 session on the 1st inst., with the customary supper and smoking concert. Mr. T. J. Lepine presided. About 70 members were present, and everyone was brimful of good spirits—at least, on the way home. Messrs. Cocking, Moon, Wallis, and others sang, and Mr. Padrischa recited passages from "Hamlet" with great success; while Mr. Dan Harrop, as the section's chief comedian, recited the third-rate poetry written for him by various members, with additions and corrections. It is particularly desired that more members should realise that they have not discharged all their debts towards the Institution when they get a receipt for their subscriptions. They still owe it the greater debt of service. They can discharge this debt by turning up in force at the meetings and by taking part in the discussions which follow the papers. Apathy is the distinguishing characteristic of electrical engineers at the present moment, and the most apathetic of all are the members of the Institution of Electrical Engineers Students' Section. Truly a hopeful lookout for the future of British electrical engineering! The fact is the students are regarded by the Institution of Electrical Engineers Council as a useful source of subscriptions, who for the doubtful benefits which membership confers on them, should be satisfied with a yearly homily and stinted expenses. There is no incentive to the average student to take any part in the affairs of the Institution. Every grade except students are directly represented on the Council, and on the local committees; the local student is separated, and indirectly touches the I.E.E. somewhere in London. Why not add a student-member of Council, elected by all the I.E.E. students to the three Associate Members of Council? What the Student Section wants is *esprit de corps*. It sadly needs a section journal printing student papers in abstract *before* they are read, giving reports of the discussions, local sections news, etc., run by the students for the students. It could be done, free of cost to members, for very little more than the present cost of the totally useless post cards which provincial students are pestered with from London during the winter. Indeed, it would very likely become a source of income for the Building Fund, from its advertisement revenue. The students' journal, with a share in I.E.E. affairs, is the only cure for the apathy which has ever been present in the Students' Section.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

An exhibition is to be opened in Leipzig about the middle of this month devoted to domestic electricity. Exhibitions of this kind ought to be greatly increased in order to arouse the interest of the general public in the application of electricity for cooking, lighting, heating and driving such appliances as washing machines and sewing machines. Such interest being aroused and a demand for such appliances created, the makers of electrical domestic apparatus would have a powerful and effectual motive for perfecting them and bringing down their present high price. The secretary of the Leipzig Exhibition is Herr. A. Mathes, Leipzig-Plagwitz Ziegelstrasse 24.

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Blast Furnaces.

The waste gases of blast furnaces have been found to prove of great service in ironworks. They can be used for combustion engines to drive dynamos which supply motors for every conceivable operation carried out at the ironworks, such as rolling plates and wire, hoisting charges to the top of the furnaces and working blowing engines. It is calculated that the cost for fuel for driving the plant with waste gases is about three-fifths of that incurred by driving it with coal, reckoning the coal at 12s. per ton and that 40% of the power is used for blowing.

High Voltage Conductors in Forests.

The Prussian Minister of Agriculture has found it necessary to issue special regulations in this matter beyond those prescribed by the German Union of Electricians. The new rules are based on the report of a committee of that Union, and are to be regarded at present as only temporary. They will be strictly enforced until further notice, but they may be altered when the committee has had time and opportunity to make further investigations and to submit a new report. The decree makes the company supplying the current responsible for all damage done to the forest by means of the wires passing through it, and also for all claims made against the forest in respect of damages caused. In the forest the high voltage wires must be worked with special safety, or special precautions. By the first alternative is understood that the tension in the wires must not exceed half that permissible elsewhere. The masts which serve in the transition between different tensions must be dimensioned according to the greatest strain towards one side. The insulators must be of such a kind and the wires must be fixed to them in such a way that on the destruction of an insulator the wire does not fall to the ground or become earthed before it falls. The second alternative means the provision of earthing bows for each mast. In all cases the trees must be cut down so as to leave a clear width of 5 metres on each side of the wires.

Economy of Long Distance Stations.

The following interesting table is based on the statistics of 56 stations of which 15 supply current for agriculture only, 18 for manufacturing purposes only, and the remainder for both purposes.

Current used.	Cost of Installation in pence per kw. hour supplied.	Cost of Installation in pence per kw. generated.	Yearly output: maximum load.
For manufacturing purposes ..	8·0	12,470	2,445
,, agricultural ,, ..	47·4	24,520	1,127
,, both ,, ..	19·7	16,080	1,770

This shows the very bad position of the centres supplying current for agricultural purposes only in very convincing fashion. Five methods are to be recommended for improving the situation:—

1. Making the area served as large as possible.
2. Obtaining the current by water power, or buying it first hand from a much larger works more cheaply than it can be made at home.
3. Enlisting the sympathy of the co-operation of public bodies.
4. Renunciation of profit on the part of credit givers.
5. Turning over the concern for a term of years to private management.

The Zoelley Turbine.

Some excellent results were given in testing a 3,500 kw. Zoelley turbine at Mulhausen. At 1,500 r.p.m., 11 atmospheric pressure, 300°C. superheating and a 94% vacuum, the consumption of steam per useful kw. hour was 6·78 kg. at half load, 6·59 at three-quarters, and 6·51 at full load. With greater superheating (350°), a better vacuum (97·5%) and an efficiency co-efficient of 96·1% for the current producer the consumption fell to 5·29 k.g. at full load. The higher figures were all superior to the guarantees of the makers.

Company Affairs.

A company has been floated in Hamburg with a capital of £60,000 under the title of Rathjens Gluhlampenwerke. G.m.b.H. It has acquired all German rights to the processes invented by Johann Rathjen of Altona, for making incandescent lamps and wires for same, at a cost of £30,000.

The ordinary general meeting of the A.E.G. accepted the dividend of 14% as against 13% for last year and approved the issue of 30 million marks additional capital in connection with the Felten Guilleaume amalgamation.

The Stettiner Elektrizitatswerke, after paying the municipality 127,717 marks (124,810) and allowances for writing off, etc., made a net profit for 1909–10 of 389,069 marks (388,891 last year). The dividend on the capital of five million marks will be 7%, as in the previous year.

The street trams of Hannover made a net profit of 2,026,077 marks for 1909. The gross takings were 6,227,569 marks as against 5,911,584 in 1908. A 3% dividend will be paid on the preference capital of 23 million marks. The debenture holders will receive 5% dividend on 5,269,500 marks of debenture capital, and 91,852 marks will be carried over.

Dusseldorf is borrowing 13½ million marks to enlarge its gas, water and electrical works.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Some important points in the design and use of high tension cable conductors were dealt with at last week's meeting in this city of the American Institute of Electrical Engineers. The subject was introduced in a paper prepared by Dr. H. S. Osborne and Professor Harold Pender, which subsequently formed the subject of an exhaustive discussion. The first part of the paper dealt with the equalisation of the stresses within the dielectric, which it was suggested might be accomplished either by separating the layers by metal foils subjected to proper potential differences, or by increasing successively the capacity of the inner layers. The first method, the authors submit, may be used in transformers and the second in the condenser type of transformer terminals by increasing the length of the inner layers of insulation. A method of increasing the capacity of the inner layers which does not require the insertion of metallic laminæ is by grading the specific capacity of the dielectric so that it is higher in the inner layers than in the outer ones. This method is particularly suited to the manufacture of extra-high-tension underground cables The grading of such cables results either in a material saving in volume of insulation required for a particular voltage and size of conductor or an increase in the voltage strength of the cable. A graded cable may be made with two layers of rubber, or an inner layer of rubber with an outer layer of impregnated paper, or three layers of rubber, or two layers of rubber with a layer of paper. The authors developed formulas which give the best theoretical design of a graded single-conductor cable of certain types for any given conditions. The effect of conductivity of the dielectric was found to be entirely negligible for ordinary materials and ordinary frequencies in alternating-current power transmission.

The Corona in Solid Dielectrics.

The second portion of Messrs. Osborne and Pender's paper was devoted to an investigation of Professor Russell's hypothesis that there exists in solid dielectrics a corona, similar to that in air, which uniformity disrupts and chars the entire overstressed portion and renders its insulation useless. They describe experiments which they made with cylindrical condensers, which, though they tended to disprove Professor Russell's hypothesis in some measure, undoubtedly demonstrated the fact that when a dielectric is overstressed, the material becomes disrupted to the extent that it presents the appearance of having been pricked by multitudinous needle-points. But the point to be observed is, of course, that since commercial dielectrics cannot be perfectly homogeneous, they only break down when overstressed at the weakest points. Finally the authors modify the old rule for finding the total electric

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strength of a graded cable and the most economical distribution of the layers, by substituting for the formula making the specific inductive capacity of each layer inversely proportional to the radius of the layer, the rule to make the product of the dielectric strength and inductive capacity of each layer inversely proportional to the radius of the layer. The discussion evoked by these pronouncements was both lively and illuminating. Professor J. B. Whitehead, of the Johns Hopkins University, emphasised the fact that the writers had made no attempt to bring their views into harmony with the ionization theory, which, he contended, could effectively explain all the phenomena exhibited in the overstressing and partial or complete breakdown of solid dielectrics; and also accounted for the weakening of the insulation. The "needlepoints," he declared, come about because impurities in the material enabled charges of overstrained adjacent molecules of the dielectric to be neutralized, thus leaving an unbalanced molecule or weak spot Mr Milton Franklin advanced the conclusion that dielectric stress corresponds to a mechanical stress, failures being due to the periodic application of the stress in alternating-current working and the ultimate fatigue of the material. Dr. Kennelly declared that it was practically impossible to make the layers in a graded cable homogeneous because of the inevitable presence of imperfect joints in the electrostatic circuit, and urged that local concentration of electrostatic flux could cause a partial breakdown which by spreading would bring about a total rupture. Mr. H. W. Fisher expressed doubts as to the charring of insulation in overstressed cables and traced breakdowns to the gradual puncturing of the insulation at its weakest points.

Practical Suggestions.

Important points were put forward by Dr. C. P. Steinmetz and Mr. W. Middleton, the latter suggesting that in making graded cables it would be better to use a combination of materials such as rubber, cambric and paper, instead of several layers of the same material; and Dr. Steinmetz, urging that it would be a mistake to use the results given in the paper as to the grading of cables, inasmuch as the conditions were very much more complex than they appeared to be at first sight. High voltage cables, he said, were probably never broken down by their operating voltage, but they break down at a weak spot, such as an air bubble, a lack of homogeneity in the insulating material or by reason of a transient over-voltage due to an electric impulse of limited energy but more or less unlimited voltage. It was, he urged, of prime importance to eliminate all weak spots from the insulating material, and to employ material requiring an appreciable amount of energy as distinguished from power to cause disruption. In the early days of the application of high-voltage cables it was suspected from the life history of the cables that a deterioration of the insulation took place by the formation of pinholes, and evidence of these phenomena was afforded by the investigation and study of the insulation in very high voltage transmission systems. In those cases where the insulation had been strained beyond its dielectric strength under conditions where no secondary phenomena such as short-circuiting arcs, had destroyed the evidence, it was common to find the surface perforated by innumerable pinholes, which, in the case of a very high voltage transmission line where the electrostatic energy is very large, reach visible size. Thus if the over-strained insulation is perforated by pinholes, either microscopic or visible, then the electrostatic field is brought to bear on the outer insulation in a concentrated form and the outer insulation is exposed to what may be called an electrostatic shearing strain. This fact explains the breakdown of a glass tube in tests at a voltage far below that which it would stand when exposed to a uniform static field.

The Doom of the Crucible.

The electric furnace formed the principal subject of discussion at the meeting in Chicago of the American Electrochemical Society, and it was shown that wherever the electric steel furnace had been installed in this country it had proved an unqualified success from every point of view, being not only a great deal more economical than the crucible method of producing steel, but, under proper conditions, very much more effective. Mr. Carl Hering opened the discussion with a paper emphasising the importance of determining the thermal conductivities of the materials entering into electrical furnaces. The method Mr. Hering proposes is to generate a measured quantity of heat electrically in the centre of a furnace, to carry off the heat from the exterior, and, when a steady state has been reached, to measure the temperature inside and outside. Mr. J. W. Richards described a method he had adopted for measuring conductivities, which consisted in using a spherical test piece through one diameter of which a hole had been bored. Into the two ends of this hole insulated carbon electrodes were inserted, and an arc was maintained at the centre of the sphere, while another radial opening permitted the insertion of a thermal couple which measured the temperature at various distances from the centre. The history of the electric furnace since the first experiment in this direction was made by Siemens 35 years ago, formed the subject of a paper contributed by Mr. Marcus Ruthenberg, who, dealing with modern developments, urged that although large furnace work had been done at constant potential, it is much better to use a constant-current multi-phase circuit. He advocated the use of slag as a conductor to save the electrodes, and recommended that joints should be avoided so far as possible and that conductors should be made too large rather than too small.

Boron for Cast Copper.

At the Electrochemical Society's meeting an important paper was presented by Dr. E. Weintraub on the use of boron in the production of copper castings of an electrical conductivity comparable to that of pure forged copper. Copper castings free from the blow-holes normally caused by the dissolution of oxygen, can of course be produced by eliminating the dissolved gases by adding small quantities of zinc, magnesium or phosphorus in order chemically to bind the oxygen, but as all these deoxidisers possess the property of binding with copper, the electrical conductivity of the casting is materially reduced. Boron, on the other hand, while a thoroughly efficient deoxidizer, has no affinity for copper, and therefore does nothing to diminish conductivity. Nor is it necessary that it be used in its pure form. It is equally effective when the sub-oxide is mixed with magnesium borate or boric anhydride, and perhaps more so, inasmuch as the boric anhydride appears to dissolve the copper oxide and bring it to the surface in the form of copper borate. Mr. Weintraub states that the foundry practice at the present time is to add one to one and one-half per cent. of this mixture, which is equivalent to 0·08 to 0·1 per cent. of boron suboxide The electrical conductivity obtained can be as high as 97·5 per cent. if the copper melted down is perfectly pure. In the foundry, where scrap copper is used, a conductivity of 91 to 95 per cent. is obtained and a guarantee of 90 per cent. is given. The resultant casting is readily machined and takes a good polish. Its tensile strength is 24,350 lb. per square inch; elastic limit, 11,450 lb.; elongation, 48·5 per cent.; reduction in area, 74·5 per cent. Castings are being made of all shapes and sizes. Sand and iron moulds can be used, and the latter are preferred. Cast copper is used in replacing forged copper, with a great saving in cost; and in replacing alloys of copper, where the gain in conductivity allows reduction in bulk and thus a saving in material. The use of this material is spreading, says Mr. Weintraub, as engineers get better acquainted with it and is already of very considerable magnitude. In many cases the effect of higher conductivity is obtained by substituting it for forged copper and eliminating rivetted, screwed or soldered joints. The cost of the boron added comes out at approximately a little under threepence for every 8 lb. of copper.

The Electric Vehicle.

The inaugural meeting in this city of the newly-formed Electric Vehicle Association of America was a noteworthy manifestation of the development of this young but vigorous industry. The president, Mr. W. H. Blood—the younger man of that well-known name—delivered an opening address, in which he traced rapidly but luminously the emergence of the electrical vehicle from the ill-informed prejudice which at one time, not so very distant, had obscured its potentialities, and outlined the scheme by

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which it is proposed to make known throughout the continent and still farther afield the fact that the electric vehicle of to-day is a perfected device which can and does perform certain definite services better and more cheaply than any other agency. Part of this work will take the form of ensuring, so far as is possible, the standardization of certain parts, including the adoption of a standard charging plug, a standard motor voltage, a standard size of batteries, a standard type of chassis, and a standard type of tyres. Some other points, such, for instance, as a universal exchange of batteries, will have to be left to the future, but on all the other points enumerated there is no reason why a beginning should not be made at once. Meanwhile with the increase in the demand the price of electric vehicles is gradually reaching a point which will make this type of automobile as popular as any other, while its thousandfold advantages over the petrol driven vehicle will naturally do all the rest. Already the cost of efficient batteries has come down tremendously now that the big manufacturing houses have come to realise the great future which lies ahead, while the newest type of batteries give such an increase in mileage power that one of the only serious disadvantages of the electric vehicle has been completely swept away. Mr. F. L. Dyer clinched the arguments of the president by an account of some electric vehicle performances. In one of these 85 to 100 miles per day were covered on a single charge of the Edison battery. In another an Anderson (Detroit) car accomplished on a single charge a run of 84 miles at an average of over 12 miles per hour over freshly tarred roads with grades as high as nine per cent., after which the excess battery capacity showed a surplus of 18 miles, giving 102 miles for a single charge; a Bailey car ran 76 miles at an average of 13·19 miles per hour, and the battery showed a surplus of 40 miles, giving a total capacity of 116 miles on a single charge. Other cars gave records of over 122 miles at 12·38 miles per hour; 139½ miles at 13·71 miles per hour, and 113 miles at 12·47 miles per hour. In another case an electric car was run for 90 minutes per day for seven days under a sealed charging socket, and at the end of the test the odometer showed 120 miles at an average of 12·32 miles per hour at a total cost of $1.42 cents, or, say, six shillings sterling! The hill trials included an ascent of 2,138 feet at a grade of 11 per cent., and 21 successful trips up the hill were made on a single charge.

The Type of Battery.

Meanwhile in Chicago, as in New York, the main question which is being discussed is the type of battery to be used. Mr. F. J. Newman, of the Woods Motor Vehicle Company, speaking at a meeting of the Electric Club, of Chicago, pinned his faith to the lead battery, notwithstanding the disadvantages of short life and rapid rate of depreciation. Mr. Newman does not believe that the Edison battery has proved itself yet, and he thinks that such great strides will be made in the near future with the lead battery that it will put all other competitors out of the market. That may be so, of course, but up to the present time it must be admitted that no effective method has been discovered of materially prolonging the life of the lead battery or stopping the drain of repairs. The future of the Edison battery seems to rest mainly on the fact that it is so radically different from any other type. It contains no lead and uses no acid. Its plates are of nickel and iron, and its activity is derived from a potash solution which brings about no sulphuration or deterioration. Overcharging causes no defects or dangers; over-rapid discharging has no effect upon it, and it may stand idle without injury; and finally, mile for mile, its weight is 50 per cent. less than that of the lead battery. It has stood every test which has so far been imposed upon it, and allowing for a certian amount of "boosting" (not in the electrical sense) it must certainly be held to have made good. This, of course, is not to say that the lead battery may not come into line or even excel it; the only thing is that the lead battery has not done so up to now, and there is no sign of such a development as Mr. Newman foreshadowed.

The Field Electric Omnibus.

The latest application of the Edison storage battery is the electric omnibus designed by Mr. C. J. Field for public service. This omnibus, which has a capacity for 30 passengers, is 22 feet long, 7 feet 4 inches wide, and has a wheel base of 13 feet 6 inches. The total weight of the car is 8,000 lbs., of which the storage batteries account for one-fifth. The batteries will run 50 to 75 miles according to roads, grades and service, this being regarded as half-a-day's service, and the motor equipment consists of two motors of 7 h.p. each, trolley car rating. The drive from the motors is direct with Morse silent chains to sprockets on the rear wheels in the ratio of 15 to 71, with 0·9 in. pitch. The front and rear wheels are 34 in. to 36 in. diameter, equipped with a 4 in. single and 4 in. dual solid rubber tyres respectively, with Timken roller bearings for city type, and floating bronze bushings for inter-urban type. The wheel construction is amply strong to meet all requirements for severe service. The axles are imported nickel chrome steel forgings having a tensile strength of 130,000 lb. per sq. in. The springs, made by Lemoine of France, of the very finest mangano silicon steel, are half elliptic with nine leaves in the front and eleven in the rear, and are practicaliy flat under load. Two-thirds of the load above the springs is carried by the rear and one-third by the front springs.

INSTITUTION OF ELECTRICAL ENGINEERS.

Students' Section.

The opening meeting of the Students' Section will take place on Wednesday, November 16, in the Lecture Theatre of the Institution, Victoria-embankment, W.C., at 7.45 p.m. An address will be given by Mr. C. H. Wordingham, M.I.E.E.

All students of electrical engineering are invited to attend this meeting, whether members of the Students' Section or not. Gentlemen desirous of attending, who are not members, are requested to send their names to the Hon. Secretary (address below), not later than Tuesday, November 8.

Programme for the Session 1910–1911.

Meetings will be held in the Lecture Theatre of the Institution, Victoria-embankment, W.C. They will commence at 7.45 p.m.

1910.

Nov. 16.—Opening Address, by C. H. Wordingham, Esq., Member.

,, 30.—J. C. Rennie: Tramway Brakes and Break-gear.

Dec. 14.—J. F. Shipley: Progress in Arc-lamps.

1911.

Jan. 19.—P. R. Coursey: Wireless Telegraphy, with special reference to "Short-spark" Methods.

Feb. 1.—H. Clark: Telephony.

,, 15.—H. C. Mary: Dry-core Lead-covered Telephone Cables.

March 15.—R. C. Plowman: Exhaust Steam Turbines.

April 12.—J. M. Bloomfield: Overhead Lines for Transmission of High-Tension Electrical Energy.

,, 26.—J. B. Sparks: Electric Traction for Main Line Railways.

May 3.—Annual General Meeting. Election of Officers and Committee for Session 1911–1912.

,, 3.—A. E. E. Cheal: Some New Zealand Electric Plants.

No programme of visits has been arranged, but suggestions with regard to visits are invited, and should be sent to the Hon. Secretary, D. Betts, 3, Fordwych-road, London, N.W.

DEVELOPMENTS IN MEXICO.

Mr. G. Hooghwinkel, of Messrs. Hooghwinkel, Anthony Brown & Partners, consulting, electrical, mechanical and civil engineers, has returned from Mexico, where his firm has opened a branch office at Calle de Cadena, No. 2, Mexico City, under the superintendence of M. Victor Braschi.

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HIGH TENSION DISCHARGES.*

By Professor E. Wilson and W. H. Wilson.

According to this new method for producing high tension discharges energy is taken from an alternating or continuous current source and stored in a magnetic field by an inductance; it is then permitted to surge into a condenser which forms with the inductance a *low* frequency oscillating circuit. When the energy is stored in the condenser the latter is mechanically bridged across the primary winding of a spark-coil, with which it forms a *high* frequency oscillatory circuit. The energy is then transmitted by the secondary winding of the spark-coil to the work circuit in well known manner.

The method therefore involves the use of an inductance, a condenser, a spark-coil, and a special contact-making device. In one form, the contact-maker consists of a cylinder of insulating material driven by a small motor, the cylinder carrying a metal segment, and a complete ring of metal attached to the segment. Three brushes (Nos. 1, 2, 3) bear upon the cylinder. No. 1 makes contact with the segment once in a revolution, No. 2 is continuously in contact with the ring, and No. 3 makes contact with the segment once in a revolution and is mounted on an adjustable arm. According to one method of connection, the coil of the inductance is connected in series with the primary winding of the spark-coil and forms one circuit. In parallel with this circuit is placed the condenser. One pole of the supply source is connected to brush No. 1 on the contact-maker. The other pole of supply is connected to a tapping point on the inductance suitable for the voltage of supply, the total number of turns on the inductance depending upon the voltage at which it is desired to charge the condenser. The junction of the inductance and the condenser is connected to brush No. 2 on the contact-maker, and is therefore continuously in contact with the metallic segment. The junction of the inductance and the primary winding of the spark-coil is connected to brush No. 3 which is capable of adjustment.

At the epoch of "make," brushes Nos. 1 and 2 are connected by the segment and the system is switched on to the supply source. The current rises in the winding of the inductance and builds up the magnetic field. The condenser also becomes charged, and its charging current passes through the primary winding of the spark-coil. At the period of "break" brush No. 1 severs contact with the segment and is insulated. The energy stored in the condenser is added to that in the inductance, and the condenser begins to be charged in the reverse direction. Ultimately the whole energy in the system is stored in the condenser. Brush No. 3 is so adjusted that, at this moment, it begins to touch the segments of the contact-maker, and thereby short-circuits the inductance The condenser then discharges with great rapidity through the primary winding of the spark-coil, and the energy oscillates to and fro. As is well known, the electromotive force induced in the secondary winding may be of an oscillatory or unidirectional character according to the nature of the work circuit. As only the current in the condenser passes through the primary winding of the spark-coil at "make," the inverse electromotive force induced in the secondary winding is so small as to be negligible, but if desired it can be entirely eliminated by a modification in the connections.

Briefly, the following are some of the advantages gained:—

(1) For X-ray work the inverse electromotive force at "make" is eliminated, thereby leading to increased life of the tube and to a more sharply defined radiograph.

(2) Only a small magnetizing current is required as the inductance has a nearly closed magnetic circuit. This gives rise to a very small C R loss and consequently higher efficiency.

(3) On account of the long periodic time of the system between the periods of "break" and "short-circuit," the voltage across the contact of the interrupter at "break" does not rise to a high value, or rises so slowly that the contacts are well separated before it is developed. Hence immunity from sparking.

(4) The method lends itself to few secondary turns and this keeps down the time constant. It also makes the coil lighter, cheaper, and more compact.

(5) The method lends itself to low secondary resistance—a point of great importance in connection with radio-telegraphy.

(6) The iron of the spark-coil can be kept small in amount, and special attention can be paid to its lamination and insulation, as it may have to be operated at frequencies of three or four thousand per second.

(7) The elimination of sparking increases efficiency, and on board ship where coal gas is not conveniently obtainable this is an advantage.

(8) The apparatus can be worked from direct current or alternating current systems at usual voltages, or from a portable battery of a few storage cells.

(9) The oscillatory current at "break" does not pass through the battery, and hence does not assist in its discharge.

(10) The iron in the magnetic circuit of the external inductance has only to operate at low frequency, and hence it has not to be finely laminated.

(11) When used on alternating current systems rectification, if desired, is easily effected by employing two short-circuiting brushes, one for each half-period, and allowing the second brush to short-circuit at the moment when the condenser is fully charged after allowing a second complete surge of the energy between the condenser and the inductance of the spark-coil.

(12) The apparatus is light, efficient and cheap, and is suitable for radio-telegraphy, X-ray, medical and other work in which high-tension electricity is employed.

The following are a few particulars of the apparatus exhibited at the meeting:—

Spark length of secondary winding	10 inches
Secondary turns	16,000 to 20,000
Primary turns	78
Secondary Resistance (aluminium)....	2900 ohms
Primary Resistance	0.056 ohm
Weight of spark-coil and condenser....	10 lbs.
Weight of inductance and interrupter..	20 lbs.

DISCUSSION.

Mr. A. CAMPBELL asked if the adjustment of the commutator was made experimentally, and if the instrument could produce high frequency oscillations suitable for wireless telegraphy.

Mr. W. DUDDELL asked if the discharge through the X-ray bulb in the experiment shown at the meeting was uni-directional.

Prof. J. A. FLEMING asked if the coil could be used for medical work. He also asked if the frequency of the discharge could be made high enough for wireless telegraphy, and commented on the small amount of sparking at the commutator.

Dr. R. S. WILLOWS suggested that the nature of the discharge in the secondary could be easily determined by using a vacuum tube rectifier.

Mr. ADDENBROOKE asked how much energy could be obtained from the secondary of the coil exhibited.

Prof. WILSON replying, said the adjustment was performed experimentally. Using an air-coil for primary, enormous frequencies could be obtained in the secondary. The efficiency of the instrument was high compared with that of ordinary coils. The electromotive force induced in the secondary was oscillatory, but in the experiment shown the X-ray bulb acted as a rectifier.

* Abstract of paper read before the Physical Society of London.

THE HUGHES MEDAL.—His Majesty has approved of the award by the Royal Society of the Hughes Medal to Professor J. A. Fleming, F.R.S., M.I.E.E., of the University College, London, for researches in electricity and electrical measurements.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ASHFORD.—At a meeting of the Urban District Council, a letter was received from the East Kent Electric Supply Company, asking the Council to consent to the grant of a provincial order to the Company, authorising them to supply electricity in Ashford and district. The letter was referred to the Lighting Committee.

BECKENHAM.—A proposal is put forward by the Electricity Committee for the opening of showrooms, to include a model electrically-fitted kitchen.

BELFAST.—The Electrical Engineer reported upon the new rules and regulations which have been forwarded to him for consideration respecting the employment of wire men and cable joiners at the electrical works, and a sub-committee was appointed to go into the matter with the Town Clerk and the Electrical Engineer and report. Short extensions of the electric mains to Wellington Park and Marlborough Park were ordered.

DROMORE.—The Urban Council have decided to adopt the electric lighting scheme put forward by Messrs. T. L. Miller, Wilson & Pegg, of Belfast. The scheme is estimated to cost £3,988, the annual expenses at £530 per annum and the revenue at £830.

EAST ASHFORD.—The East Kent Electricity Supply Company, Ltd., by an oversight omitted to give the Rural District Council notice under Section 4 (1) of the Electric Lighting Act, 1882, and asked that the informality should be waived. It has been decided to ascertain whether the company proposed to adopt the overhead or underground system of transmission, and the rates, before complying with the request.

GLOUCESTER.—The Town Council are applying to the Local Government Board for powers to raise £14,000 to be expended on electricity works extensions. The proposals are to instal a 750 kw. steam turbine with condenser switch gear, etc., also mechanical stokers for two of the existing boilers, one steam feed pump, one 150–200 kw. motor generator with switch gear, etc., and some other plant, at an estimated cost of £6,730; also feeders, distributing mains and services, £6,092. It is also necessary to apply for borrowing powers in respect of capital expenditure in excess of loans already sanctioned amounting to about £1,500; making a total sum required of £14,322.

LEYTON.—The Council have decided to expend £7,000 on a new turbine set and accessories. The capital charges on this amount assuming a loan for 20 years at 4% would be £515 per annum. The economy resulting from the use of the exhaust steam portion of the turbine in conjunction with the existing plant would be at least 15%, and as the coal bill of last year was £5,520, the saving in fuel expenses would amount to £783 per annum. Application will be made to the Local Government Board for sanction to a loan of £7,000.

LONDON: MARYLEBONE.—The revised charges made by the Borough Council at the model dwellings are 7d. a week per sitting-room electric lamp, 5d. per bedroom lamp, while carbon filament lamps for bedrooms are supplied at 3d. a week.

MAIDSTONE.—The Local Government Board have sanctioned the raising of a loan for £1,431 by the Council for electricity undertaking extensions.

PICKERING.—The Board of Trade propose to revoke the Pickering Electric Lighting Order, 1901, which authorised the Northern Counties Electricity Supply Company, Ltd., to supply energy in the Pickering urban district.

TODMORDEN.—A new engine and dynamo at the municipal electricity works is now in working order. The new generating set, which practically doubles the possible output of the station, consists of a Belliss and Morcom engine direct coupled to a P.D.M. generator, the contact having been let to the Phœnix Dynamo Manufacturing Company, Bradford.

WEST HAM.—It is somewhat disappointing to find that with an increase of revenue of over £7,300 as compared with 1909, the Corporation electricity undertaking should show a reduction in gross profits of over £2,350, and an actual deficiency of £2,900, this latter amount being taken from reserve, which now stands at the very low amount of £2,081. It is fair to point out, however, that rates and taxes have jumped up from £114 to over £5,286. The total revenue, it should be stated, was £79,454 and the production and management expenses £48,813.

OVERSEAS.

BILBAO. British imports of electrical machinery and appliances through this port for 1909 only amounted to 22 tons out of a total of 514 tons of such imports, but strong efforts are being made to introduce British machinery, so far with success.

MELBOURNE.—The Victorian Government propose to instal an electrical plant at the State coal mine at Wonthaggi, at a cost of about £25,000. It is intended to provide power for haulage underground and on a surface tramway running from the brick-works to the mine and the township, for lighting, pumping and ventilating the mine, and for lighting the town.

SYDNEY.—Specifications are being prepared for wireless telegraphy stations to be established at Thursday Island and at Port Moresby, Papua, and that tenders in this connection are to be invited at an early date. Each station is to have a range of about 600 miles.

THE HAGUE.—A commission has been formed, under the presidency of Mr. J. E. Schalten, with the object of constructing a central electric generating station for the provinces of Groningen, Drente, and Overijssel.

TIFLIS.—The Municipality will shortly invite tenders for the erection of an electric generating station.

TORONTO.—According to the "Standard of Empire," the Government hydro-electric power system, recently inaugurated by the Provincial Premier, the Hon. Sir James Whitney, is being extended to Ontario's industrial centres with all speed. The lines have now reached Guelph and Waterloo from Niagara, and power for manufacturing and domestic purposes is now available in these cities. Although the hydro-electric system has only been in operation a few weeks, many important industrial developments are expected to follow soon. Cheap power is the one thing needful to keep Ontario to the fore as a great manufacturing as well as a great agricultural and mining Province.

TRACTION.

HOME.

BINGLEY.—Keighley have applied to the District Council for permission to run cars on the trackless trolley system through Bingley, it was agreed that the Council grant Keighley the permission to run trams on the trackless trolley system on their present motor omnibus route for a period of fourteen years on condition that a payment of £350 a year be made for wayleave, that the fares charged should be the same per mile as in Keighley, and that Keighley supply electricity in bulk to the Council, if required, at the lowest rate and to conditions on other matters as might be arranged between the Council and the Corporation.

BRIGHTON.—The proposal to link up the Worthing and Brighton tramways having been rejected by so narrow a majority of the Brighton Town Council, the promotors have decided to apply to Parliament for powers. The Hove Corporation have decided to offer opposition.

HULL.—A scheme of tramways extensions has been sanctioned by the Corporation Tramways Committee. Extensions on four routes are outlined in the scheme, which includes also a new route, whereby passengers can be carried to and from Paragon Station to any part of the city. Parliamentary powers are to be applied for.

KIRKINTILLOCK.—At a public meeting held at the Town Hall, a strong resolution in favour of the Glasgow Tramways being extended to the town was passed.

OVERSEAS.

BUENOS AYRES.—The Compañia Electrica del Norte has applied to the Government of Santiago del Estero for a concession for electric tramways in that city.

ROME.—The Public Works Department have approved an application for a concession to construct an electric railway from Argegno to Lanzo d'Intelvi.

COMPANIES' MEETINGS AND REPORTS.

CAPE ELECTRIC TRAMWAYS.

The directors, in their report for the year ended June 30 last, state that the profit and loss account, after providing for debenture interest and redemption of debentures, and taking into account the balance brought forward from last year, shows a balance to credit of £9,047, which has been carried forward to next year's account. During the year the tramways carried in Cape Town 12,207,739 passengers, earning £119,936, against 11,888,180 passengers, earning £117,714, for the preceding year. In Port Elizabeth 3,102,286 passengers were carried, earning £32,882, against 2,978,217 passengers, earning £31,455, for 1908-9. The profits of the past year earned by the sub-companies show an

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increase for the year 1909-10 of £13,062. This greatly-improved result justified the writing off the total amount remaining of the flood losses at Port Elizabeth, which it had been originally intended should have been spread over a period of years.

AUCKLAND ELECTRIC TRAMWAYS.

The total revenue of the Auckland Electric Tramways Company, Ltd., for the half-year ended June 30 last amounted to £97,000. The traffic receipts totalled £95,800, an increase of £6,500. After deducting all expenses chargeable to revenue, including £8,200 for debenture interest, and £2,300 in respect of the rental and percentage of profits payable to the Auckland City Council, and setting aside £7,500 to depreciation account, there remains a surplus of £20,500, making, with £3,500 brought forward, a total of £24,100. From this amount £6,000 has been placed to reserve, and, after paying a dividend on the ordinary shares at the rate of 6% per annum, there remains to be carried forward £6,100. Since January 1 last £3,470 of 5% first mortgage debenture stock has been redeemed at 105%, leaving £325,532 of this stock still outstanding. Capital expenditure for the six months amounted to £15,200, the largest portion of which was in connection with the extension of the power house plant and distributing system.

NORWICH ELECTRIC TRAMWAYS.

The annual general meeting of the Norwich Electric Tramways Company was held at Crosby-square, London. The accounts for the year ending June 30 last showed a profit on the year's working of £8,377 18s. 11d. With interest and transfer fees the gross profit for the year was £8,549 12s. 2d., the total amount standing to the credit of the profit and loss account being £8,747 7s. 11d. From this had to be deducted the sum of £2,640, 4% interest on the company's mortgage bonds for the year, leaving a sum of £6,107 7s. 11d. to be dealt with. The directors recommended that out of this £2,500 be placed to the reserve fund account, that a dividend of 1¼%, amounting to £3,300, be paid, and that the balance of £307 7s. 11d. be carried forward. This was agreed to. Mr. George Chamberlin was re-appointed a director as the representative of Norwich, Mr. E. A. Hopkins was also re-elected a director, and Mr. Fred S. Culley, Norwich, was re-elected auditor.

THE EDISON AND SWAN UNITED ELECTRIC LIGHT.

The 27th annual report for the business year ending June 30, 1910, states that the net revenue account shows that the sum of £23,233 17s. 5d. has been brought forward from profit and loss account. Interest on debenture stocks has absorbed £15,701 16s.; £5,500 has been set aside as depreciation on freehold and leasehold property, plant, and tools; £4,000 has been applied in writing down values of stocks, and the sum of £1,216 5s. 3d. has been reserved on account of bad and doubtful debts. The result as shown in the net revenue account is a debit balance of £3,184 3s. 10d., which must be deducted from the sum of £10,027 7s. 6d., brought forward from the previous year, thus leaving a sum of £6,843 3s. 8d., which the directors propose to carry forward. Cost of establishing the business, goodwill, etc., £390,432 8s. 1d., has been brought forward at the figure standing in the last balance sheet. The freehold and leasehold property and plant have also been brought forward at the value stated in the last balance-sheet, with the addition of the amount expended to June 30, 1910, less depreciation charged in net revenue account. The shares of the Altrincham Electric Supply, Limited, have been taken at par, as in previous years. This concern continues to be satisfactory, and has paid a dividend on its shares of 7 per cent. for the year ended December 31, 1909. Its indebtedness to this company has been reduced during the year by £275 9s. 1d. There has been expended on capital during the year ending June 30, 1910, £5,931 0s. 3d., mainly on account of additions to buildings and plant in connection with the manufacture of metal filament lamps. The directors regret that the year's trading has not been more satisfactory. This is due mainly to the high costs of production of metal filament lamps which prevailed during the earlier part of the year. The directors are glad, however, to be able to state that these costs have been largely reduced during the later part of the year under review, and they are of opinion that the current year should show a marked improvement as a consequence, judging from the results produced during the months which have elapsed since the close of the financial year, which have been of a satisfactory character.

COMPANIES REGISTERED.

ERNST HILDEBRANDT.—Capital, £5,000, in £1 shares. Objects: To carry on the business of manufacturers of ceramic articles and accessories used in the incandescent gas light and electrical industries, and to acquire the undertaking in England of Vereinigte Magnesia Company, und Ernst Hildebrandt Aktiengesellschaft, of Pankow-Berlin. Private company. The directors are to number not more than five. J. Schmidt is the first director. The said company has power to appoint other directors. Remuneration, as fixed by such company. Registered office, 44, Croft-street, Lower-road, Deptford, E.

EDUCATIONAL.

INSTITUTION OF CIVIL ENGINEERS: YARROW EDUCATIONAL FUND.

This fund was established to afford assistance to young men who desire to become engineers, who have given proof of their capacity to profit by specialised education and training, but who lack sufficient means to obtain it. Grants varying between £50 and £100 per annum, for a period not exceeding three years, may be made in the discretion of the Committee. Applicants for such grants must be of British birth, not more than 21 years of age, and must be prepared to qualify for attachment as students of the Institution of Civil Engineers. Several vacancies for scholarships under the fund will occur in March, 1911, and the Council of the Institution are prepared to receive and consider applications therefor. Applications should be addressed to the Secretary of the Institution of Civil Engineers, Great George-street, Westminster, S.W. Every application should contain a brief statement of the candidate's age, parentage, and career, as well as his proposal with respect to his future engineering training. The application must be accompanied by testimony as to the character and ability of the applicant from his past or present schoolmasters or employers, and by evidence of the fact that means are not available to complete his engineering training. Further particulars may be obtained on application to the Secretary of the Institution.

UNIVERSITY COLLEGE, LONDON.

Professor J. A. Fleming, F.R.S., will deliver a course of advanced lectures on "The Theory and Practice of Electrical Measurements with Special Reference to Telegraphy and Telephony," at University College, on Wednesday afternoons, at 5 p.m., beginning January 11, 1911. The Course is designed to meet the needs of postgraduate students, teachers, telegraph, telephone and electrical engineers generally possessing some knowledge of the subject of electrical measurements, but desiring to make a further study of the advanced theory and practice. As only a limited number of students can be admitted, early application should be made. Full particulars may be obtained from the Secretary of the College.

FINANCIAL NOTES.

BUENOS AYRES TRAMS.—The directors of the City of Buenos Ayres Tramways Company (1904), Limited, have declared a dividend of 1s. 3d. per share, less income tax, for the three months to September 30.

* * *

SILVERTON TRAMWAY.—The directors of the Silverton Tramway Company, Limited, have declared an interim dividend of 1s. per share.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

CONTRACTS.

THE CALCUTTA ELECTRIC SUPPLY CORPORATION, LIMITED.

COSSIPORE STATION AND SUB-STATIONS.

The CORPORATION are prepared to receive tenders for the supply, delivery and erection at their Cossipore Station and Sub-Stations, Calcutta, of the following:—

Specification No. 9.—Overhead Electric and Hand Travelling Cranes, with Rails, Conductors, Motors, etc.

Copies of this Specification, along with the Drawing and General Conditions of Contract, can be obtained on and after November 11, from the undersigned, on payment of a fee of Two Guineas, which will be returned on receipt of a bona-fide Tender, or on the return of all the documents with a satisfactory explanation as to the Contractor's inability to tender.

Each Tender, which is to be written on the form at the end of the Specification, must be enclosed in a sealed envelope endorsed on the outside, "Electric Plant, Tender to Specification 9," and sent to the Secretary of the Calcutta Electric Supply Corporation, Limited, Salisbury-house, London-wall, E.C., so that it can be received by him not later than 10 o'clock on December 1, 1910.

The Corporation do not bind themselves to accept the lowest or any Tender, and no allowance whatever will be made for expenses incurred in the preparation of a Tender.

FRANCIS R. REEVES, Secretary.

The Calcutta Electric Supply Corporation, Ltd.,
Salisbury-house, London-wall, E.C.
November 8, 1910.

GENERAL POST OFFICE.

SALE OF CONDEMNED POST OFFICE STORES.

TENDERS are invited for the Purchase of a quantity of TELEPHONE EXCHANGE FITTINGS, comprising Hardwood Cabinet Frames, Iron Switchboard Framework, Switchboard Cable, Keys, Jacks, Pegs, Indicators, Relays, Scrap Brass, Aluminium, etc., also

1 Air Compressor,

1 Motor 250 v. 2·5 h.p. (by Mayor & Coulson),

1 Starting Switch (by Mayor & Coulson),

and a quantity of other Instruments, Instrument Parts and Battery Stores, in convenient lots.

The lots are lying at:—

GLASGOW—65, Renfield-street;
" Waterloo-street Store;
" Bath-lane Depôt;
" Clyde-place Store;

and may be viewed on Monday and Tuesday, November 14 and 15, 1910, between the hours of 10 a.m. and 4 p.m.

A form of tender containing all particulars can be obtained on application to the CONTROLLER OF STORES, G.P.O., 17-19, BEDFORD-STREET, LONDON, W.C. Tenders will be received until 10 a.m. on Wednesday, November 16, 1910.

The Postmaster-General does not bind himself to accept the highest or any tender.

BY ORDER OF THE POSTMASTER-GENERAL.

General Post Office,
November 8, 1910.

OSRAM LAMPS

CONTRACTS OPEN.

HOME.

BRADFORD.—Corporation Tramways.—Miscellaneous stores. (Specification, £1 1s.), from the Manager. November 12.

BOOTLE.—The Corporation invite tenders for the electric light installation at the New Balliol Council Schools, Bootle. Particulars from the Borough Engineer. November 17.

COLWYN BAY.—Urban District Council.—Switch panel, including switches and instruments. (Specifications, 10s. 6d., Electrical Engineer, at works). November 12.

HULL.—The Electricity Department invite tenders for unwashed slack for 12 months. Particulars from Electrical Engineer. November 15.

LONDON.—The Port of London Authority invite tenders for the supply of materials and stores for twelve months ending December 31, 1911. Specifications from the Manager of the Stores Department, 106, Fenchurch-street, E.C. November 19.

LONDON, FOR CALCUTTA.—The Calcutta Electric Supply Corporation, Ltd., invite tenders for the supply of overhead electric and hand travelling cranes, with rails, conductors, motors, etc. (Specification No. 9). Particulars from The Secretary, Calcutta Electric Supply Corporation, Ltd., Salisbury-house, London-wall, E.C. December 1.

WARRINGTON.—Borough Council.—Annual supply of motors and transformers. (Particulars from the Electrical Engineer). November 15.

WELLINGTON.—Corporation.—Steam piping for electric lighting department. (Particulars from J. H. Woodward, 8, Queen Anne's-gate, S.W.) November 17.

OVERSEAS.

AUSTRALIA.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on December 6, for the supply of (1) cable testing instruments (Schedule No. 336) and (2) 6,000 jacks (Schedule No. 385). Tenders will be received at the office of the Deputy Postmaster-General, Adelaide, up to noon on December 29, for the supply of (1) battery and line material, and telegraph and telephone instruments (Schedule No. 147), and (2) telephone cable (Schedule No. 149). Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to 2.30 p.m. on January 4, 1911, for the supply of 3 multiple-magneto switchboards (Schedule No. 45). A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to each of the above contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham House, Old Broad-street, E.C., and Central House, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a *bona-fide* tender.

NOTES.

New Insulating Material.

It appears that Mr. O. U. Thomas, the Penang Municipal Electrical Engineer, has produced an insulating compound, a sample of which he has had under observation and test for nearly a year, which possesses advantages not found in the systems in general use. In the event of this new insulating medium proving successful, there is a wide field for its use. As Mr. Thomas points out, in Penang, during the year 1909, there were no less than 36 "faults" in the insulation of the cables comprising the electricity supply

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
HULL.

distributing network. The cost of repairing them amounted to nearly £1,250, exclusive of that of services of engineers which is a fixed municipal charge. There is a similar experience and proportionate cost all over the tropics, to say nothing about Europe and other parts of the world, and electrical engineers will therefore welcome any new insulating material which promises greater reliability, even at an enhanced initial outlay. But the outlay involved in the new invention is stated to be considerably less than with existing systems, and while the inventor had mainly in view the production of a more satisfactory insulating medium for underground electric cables, he is confident that his material will also be in demand for the insulation of the small cables and wires required for house installations, etc., as its inherent lasting properties promise to render it a valuable substitute, particularly in the tropics, for rubber, which is now almost exclusively used for this purpose.

Electricity on the "Balmoral."

The Royal visit to South Africa has naturally received much attention at the hands of the daily press, but among the numerous details appearing therein little mention has been made of the great preparations which were made in order to administer to the comfort of the Duke of Connaught and his suite during their voyage. It will doubtless be a matter of great interest to members of the electrical profession to learn that the lighting of the luxurious

saloons of the "Balmoral Castle" was effected by means of "Tantalum" lamps. We reproduce above a photograph of the "Dining Saloon," which shows a splendid example of an up-to-date steamship installation of to-day. Apart from the very pleasant and very satisfactory illumination afforded by "Tantalum" lamps, the "Tantalum" filament withstands with ease the vibration and severe treatment to which lamps used on board ship must always be subjected, and metal filament lamps of so strong a type readily find acceptance among shipping circles. This is only one of a large number of ship installations, proving that the high efficiency "Tantalum" Metal Lamp is again favoured for use on steamships. A glance at the illustration will show that the apartments of a first-class steamship are very similar to those of the latest palatial hotels, and the electrical trade in general will no doubt be interested to note that among the many other important details of the voyage to the Cape, no attention has been spared which would tend to bring the electrical installation to the utmost perfection.

Rubber Belting.

One of the many lines of their business for which The India Rubber, Gutta Percha & Telegraph Works Company, Ltd., have a world-wide reputation is "Silvertown" Belting, both rubber and balata. Quite a large and important contract has just been fulfilled to the order of Messrs. Spencer & Company, Ltd., of Melksham, for the Hull and Barnsley Railway Company. Two large rubber belts (shown in the illustration ready for despatch) are to be used for loading vessels with coal at the Hull Docks by a new patent conveyer system which has already been successfully applied by the North Eastern Railway Company for the same purpose, and for which Messrs. Spencer & Company have the sole rights of manufacture and supply. The plant will be electrically driven. The belts are 953 ft. and 929 ft. long, and weigh 12,071½ lbs. and 11,740¾ lbs. respectively.

Gas Engine Awards.

Messrs. Crossley Bros., Ltd., of Openshaw, Manchester, have received the Grand Prix both at the International Exhibition, Brussels, and the Argentine Centennial Exhibition, Buenos Ayres, for their "Otto" gas engines.

Mill Equipment.

Extensions are being made to the electrical equipment at the Haverton Hill Wells, belonging to the Salt Union, Ltd., of Port Clarence, Middlesbrough, in the area of the Cleveland and Durham Electric Power Company. According to the "Newcastle Chronicle," the company is putting up a new overhead line with three cables at 2,750 volts, for the purpose of supplying these wells. At the further end of this pole line new sub-station plant is being installed in the existing building. This consists chiefly of three transformers which transform the power from 2,200 volts down to 220 volts, and which are controlled by switchgear of the pedestal type on the high tension side, and protected by fuses of the Reyrolle type on the low tension side. The power after being transformed to this lower pressure in the sub-station is employed in the wells for driving centrifugal reservoir and well pumps which are driven by three-phase motors running at 440 volts, and at speeds of 755 and 1,140 revolutions per minute respectively. The motors are of the Westinghouse type. The wiring is being carried out by Messrs. Jarvis Bros.

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INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

Programme of Centre Meetings, Session, 1910-11.

METROPOLITAN CENTRE.—1910.—Nov. 14: "The New Central Power Station," H. C. Gunton; Dec. 12: "Life and Behaviour of Primary Batteries Used for Telephone Purposes," J. G. Lucas.

1911.—Jan. 9: "Testing Paper Core Underground Cables during Construction," L. J. Sell; Feb. 13: "Conveying Systems," E. W. Pettit; March 13: "Principles and Methods of Using Small Power Engines," H. R. Rivers Moore; April 24: General annual meeting.

EASTERN CENTRE.—1910.—Nov. †: Opening addresses, J. F. Lamb; Nov. 29: "Unit Maintenance Cost System," R. J. S. Gold; Dec. †: "Central Battery System of Telephony," T. Cobbe.

1911.—Jan. †: "The Training of a Lineman," E. T. Titterington; Feb. †: "Paper Core Cable Faults, their Localisation and Removal," A. R. Nichols; March †: "A Few Notes on Road-making, Repairs, etc.," A. Evans.

MIDLAND CENTRE.—1910.—Nov. 30: "Unit Maintenance Cost System," R. J. S. Gold; †, "Modern Telephone Systems," J. G. Hill; †, "Internal Wiring and Cabling of Offices," W. E. Twells. A Paper by Mr. Cave Brown Cave has also been promised.

NORTH-EASTERN CENTRE.—1910.—Nov. 28: "Unit Maintenance Cost System," R. J. S. Gold; Dec. 19: *, T. E. Herbert.

1911.—Jan. 16: Annual meeting; Feb. 13: "Office Organisation," G. H. Hoole; March 13: "Maintenance and Duties," J. D. Taylor.

NORTHERN CENTRE.—1910.—Nov. 14: "Some Points in Open Line Construction," T. B. Johnson; Dec. 12: "Aerial Cables," J. McKenzie.

1911.—Jan. 16: "Organisation," J. R. Andrews; Feb. 14: "Telephoning of Small Towns," T. Patterson; March 14: "Notes on Building Construction," H. Kitchen.

NORTH-WESTERN CENTRE.—1910.—Nov. 7: "Wireless Telegraphy," A. C. Timmis; Dec. 5: "Unit Maintenance Cost System," R. J. S. Gold.

1911.—Jan. 9: "Selenium: Photo-Electric Effects and Photo-Telegraphy," W. B. Smith; Feb. 6: "The Maintenance of Trunk Sections in Primary Battery Exchanges," G. Bowyer; March 6: "The Clerical Work of a Sectional Engineer's Office," S. C. Leggett and A. Rowbotham.

NORTH WALES CENTRE.—1910.—Nov. 16: "Section Stocks," T. Adams; Dec. 8: "Unit Maintenance Cost System," R. J. S. Gold.

1911.—Jan. 10: "Underground Construction," J. Crane; Feb. 8: "Methods of Statistics," A. S. Renshaw; March 16: "Contractor's Accounts," T. Plummer; April 12: "Notes on Building Materials," F. Horner. Visits will be arranged to: Seaforth Wireless Station, Lever's (Port Sunlight), Railway Signal Works, Fazackerly.

SOUTH WALES CENTRE.—1910.—Nov. 8: "First-Aid: Its Aims and Objects," Sergeant D. J. Francis (Superintendent of the Police Division of the St. John Ambulance Brigade); Visit to the Engineering Shops of the University College of South Wales and Monmouthshire, conducted by Professor A. C. Elliott; Dec. 13: "Sound, Light, and Heat" (Illustrated by Lantern Slides), J. H. M. Wakefield.

1911.—Jan. 10: "Circulars E. 11 and 12," a discussion to be opened by H. G. Tissington; Feb. 14: "Secondary Cells," C. M. Herbert; March 14: "Short Submarine Cable Across Docks and Rivers" (illustrated by Lantern Slides), H. Cranage; Visit to Ebbw Vale Company's Works.

SOUTH-WESTERN CENTRE.—1910.—Nov. 14: "Unit Maintenance Cost System." R. J. S. Gold. Particulars of other meetings not yet available.

SCOTLAND EAST CENTRE.—1910.—Nov. 9: "Slide Rule," James Patrick; Nov. 30: "Training of Linemen," B. J. Gill; Dec. 14: "General Submarine Work," F. H. Machugh.

1911.—Jan. 11: "Construction of Heavy Main Lines," John Patrick; Feb. 8: *, C. Crompton; March 8: "Notes on Aberdeen Underground," E. Slader; March 29: *, C. J. Mercer; April 19: "Leading-in Arrangements at Edinburgh H.P.O.," J. McIntyre.

IRELAND CENTRE.—1910.—Dec. 7: "Unit Maintenance Cost System," R. J. S. Gold. Particulars of other meetings not yet available.

* Subject to be announced later. † Date not yet fixed.

PRESIDENT'S AWARDS.—Last day for receipt of papers for these competitions is January 31, 1911. The notification of intention to compete must reach the Secretary not later than November 30, 1910.

DIARY.

FRIDAY, NOVEMBER 11.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, South Kensington, at 8 p.m. Dr. C. Chree: "On the Supposed Propagation of Equatorial Magnetic Disturbances with Velocities of the order of 100 miles per second." Mr. J. S. Dow: Exhibition of a Brightness Photometer.

SATURDAY, NOVEMBER 12.

GLASGOW TECHNICAL COLLEGE SCIENTIFIC SOCIETY.—At 7.30 p.m., Mr. Robert Lang, M.I.Mech.E., on "Modern Lathes and Methods."

MONDAY, NOVEMBER 14.

INSTITUTION OF MECHANICAL ENGINEERS' GRADUATES ASSOCIATION.—At the Institution, Storey's Gate, Westminster, at 8 p.m. Mr. Ernest Timothy on "Foundry Plant, Machinery and Working."

MONDAY, NOVEMBER 14.

JUNIOR INSTITUTION OF ENGINEERS.—Reception, Dance and Whist Drive at Caxton Hall, Westminster. Tuesday, November 15, at Junior Institution of Engineers, Royal United Service Institution, Whitehall, Presidential Address on "The Influence of Pure Science in Engineering," by Sir J. J. Thomson, F.R.S., Cavendish Professor of Experimental Physics at the Cambridge University.

TUESDAY, NOVEMBER 15.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Students' Section).—At the Municipal School of Technology, Manchester, at 7.30 p.m. Mr. Allan Monkhouse on "Recent Electric Locomotive Practice and the H.T. Direct Current Railway System."

WEDNESDAY, NOVEMBER 16.

INSTITUTION OF ELECTRICAL ENGINEERS (Yorkshire Section).—At the University, Leeds, at 7.15 p.m. Inaugural Address by the Chairman, Mr. T. Harding Churton.

FRIDAY, NOVEMBER 18.

INSTITUTION OF ELECTRICAL ENGINEERS (Glasgow Students' Section).—At the Glasgow Technological College, at 8 p.m.

PATENTS.

Electric Colour Photography.

30188.—1909. A. C., AND L. S. ANDERSEN, Copenhagen. This is an improved apparatus for transmitting images of natural objects to a distance by means of a single conductor in which the different parts of the image are successively projected by the perforations in a movable screen upon a selenium cell connected in an electric circuit, the variations in the intensity of the illuminations thus produced causing variations at the receiving station in the amount of light received by a similar screen to that at the transmitting station, with which the movement is synchronous. According to the invention a prism is arranged at the focus of a lens which receives the rays proceeding from the object, the image of which is to be transmitted. The rays dispersed by the prism fall on a perforated rotating disc which distributes the rays successively on to the selenium cell. A coloured disc at the receiving station corresponding to the perforated disc at the transmitting station and rotated at the same speed determines the colour of the rays which produce the image projected on the screen at the receiving station.

Electric Lamp Holders.

12603.—1910. S. B. TREIBERG, Avondale, U.S.A. This is an improvement in lamp-holders of the class designed for portable attachments of incandescent lamps for furniture. The holder comprises a pair of integrally united jaws of a width in excess of the distance between the jaws and a tongue projecting outwardly from the heel of one of the jaws and made integral with it, and provided with means to be engaged by an electric lamp.

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Electrically Operated Switches.

1146.—1910. GENERAL ELECTRIC COMPANY, Schenectady, U.S.A. This is an improvement in motor control systems as described in patent 7113.—1909. The improvement consists in arranging the notching relays so that they operate not only to control the successive closing of the contractors which control the potential applied to the motor, but also so that they serve as overload relays, which, upon an excessive overload will cause the opening of the control switches and thereby protect the motor, either by reducing the potential applied to it or interrupting the connecting with the source. Another feature of the invention consists in improvements in the notching relays used in systems of control of the general nature of that set forth in the patent referred to. By means of these improvements relays may be provided in which the movable magnetic core will be released by the series coil at the same current in the latter regardless of the position in which it is when raised.

Purifying Liquids by Electricity.

1459.—1910. H. B. HARTMAN, Pittsburg, U.S.A. The liquid is caused to flow between electrodes and subjected to the action of an electric current. The circuit is made and broken when starting and stopping the flow of the liquid in such manner as to maintain the current flow longer than the liquid flow. A further patent (1460—1910) describes an improved electrode box in which the electrode plates are arranged in sets through which the liquid is caused to flow in a zig-zag course. Between the sets of plates is an intervening re-action space, provided with a baffle. The re-action space is of greater cross sectional area than the passage between the plates.

Electric Frequency Transformers.

4263.—1910. SIEMENS SCHUCKERTWERKE, G.M.B.H., Berlin. The object is to provide arrangements whereby the armature magnetising current may be dispensed with, and whereby the magnetisation of the frequency converter can be effected by means of windings on the other parts of the machine. The stator winding is energised from brushes on the commutator of the transformer, combined with means for regulating the value of the voltage applied to the stator winding and for regulating either the phase of the voltage applied to the winding, with respect to the phase of the brush voltage or the nagular position of the stator.

Magnetic Separator.

5684.—1910. G. RIETKÖTTER, AND A. KUHN, Hagen. The magnet is composed of two divergent coils through which a laminated core is passed. After issuing from the coil the individual laminæ is divergingly projected on the drum which rotates round the magnet. The two sets of lamiuæ converge so as to form a continuous magnetic field.

Electrically Driven Vehicles.

24016.—1909. GENERAL ELECTRIC COMPANY, Schenectady, U.S.A. The overhead current collecting device for driving trackless vehicles comprises a pyramid shaped head connected by a ball joint to the trolley pole. Contact shoes are secured on opposite sides of the head.

Electric Switches.

8080.—1910. A. P., G. C., & P. A. LUNDBERG, Islington. This invention has reference to switches embedded in a wall, covered by a plate flush with the wall surface, and actuated by a push button. It has been proposed to constrain the button to move rectilineally by the engagement of pins carried in slots formed in fixed members and in a lever connected with the movable and contact-making members of the switch. The invention consists in the adaptation of such switch operating mechanism to an electric switch the movements of whose contact-making members are affected by a tumbler lever that has a knob at its free end, and a ball at a point between the ends, the ball being mounted in a recess formed in a bridge piece in such position that the end of the lever connected to the movable and contact-making members of the switch is between the legs of the bridge piece. According to the invention, the knob is dispensed with and replaced by a slotted lever. The lever is mounted in the ball of the tumbler lever so that it is at right angles to the tumbler lever, and extends in the plane of its motion. The fixed and slotted members are attached to the legs of the bridge piece.

Driving Train Lighting Dynamo Electric Machinery.

11024.—1910. A. G. BROWN, BOVERI & COMPANY, Baden. This is an improvement in driving train lighting dynamos, and consists in connecting a track wheel axle to bevel gearing which transmits the axle rotation to the dynamo by a flexible coupling. This allows a relative movement between the dynamo and wheel axle.

Dynamo Electric Machines.

14125.—1910. ALLGEMEINE ELEKTRICITATS GESELLSCHAFT, Berlin. This is an improvement in dynamo electric machines constructed according to Patent 13864.—1904. The improvement consists in dispensing with and moderating certain parts of the machine so as to ensure coolness of the rotating field magnets.

Electrically Insulating Armature Coils.

14961.—1910. M. MEIROWSKY, Cologne-Ehrenfeld. The process consists in causing the revolution of the body to be insulated to impart movement to an endless band hung round it and kept in tension. The insulating material is introduced between the band and the coil to be insulated, and is uniformly pressed on the coil whatever its cross section may be.

Alternating Current Solenoids for Operating Electric Controllers.

15417.—1910. G. A. E. KOHLER, Chicago. This alternating current solenoid comprises a core, a conducting sheath, and a strip of material in proximity to the core. Windings are associated with the core and strip so as to produce magnetism in the core when alternating current is passed through the windings.

Armature Windings for Dynamo Electric Machines.

8410.—1910. SIEMENS-SCHUCKERTWERKE, G.m.b.H., Berlin. This is a composite armature coil for a dynamo electric machine having only one bend of the kind which changes the relative positions of the conductors. The bend is situated at the commutator end.

Electric Circuit Controlling Device.

7276.—1910. J. F. KELLY, Pittsfield, U.S.A. The device has a receptacle which contains a body of conducting liquid. A curved guiding surface projects down into the receptacle below the surface level of the liquid. One or more contact terminals are in recesses in the guiding surface. A perforated sheet of flexible non-conducting material is moved through the liquid against the guiding surface to control access of liquid to the contact terminal.

Telephone System and Individual Transmitters.

8332.—1910. C. L. CHISHOLM, Marysville, Canada. The local stations transmitter circuits are provided with accessible circuit terminals and transmitters capable of being carried by the users and so being individual to them and applicable to, and removable from, the accessible transmitter circuit at any of the stations at will and without the aid of tools.

Distributors of Magneto Ignition Machines.

10780.—1910. ETABLISSEMENTS DE DION BOUTON, Puteaux. The object is to attach the cover of a secondary current distributor to the frame of a magneto in such a way that while it will be securely held in place, it will at the same time allow removal to be easily effected. The attachment is made by means of a rod passing through the hollow shaft of the distributor and secured at one end to the distributor cover by means of a bayonet or similar coupling. The rod is spring controlled to cause it to hold the distributor cover to its seat upon the magneto frame.

Electric Contact Makers.

11281.—1910. MCKENZIE & HOLLAND, LTD., & S. P. WOOD, Westminster, S.W. The contact wires are secured in the flattened end of a glass tube. A body of mercury in the tube makes contact with the wires. Copper wires are joined to the contact wires within the tube, and although they are held in place, they have room to expand without fracturing the tube.

Working Arc Lamps in Series with Incandescent Lamps.

11582.—1910. A. HEIMAN & W. SCHAFER, Berlin. This improved method for working incandescent and arc lamps in common on an alternating current circuit with the use of an auto-transformer, consists in the employment of variators connected in front of the arc lamps and adjusted for a slightly higher strength of working current than the arc lamps whereby the strength of current in the lamp circuit is limited to a value slightly above the normal strength of current.

Electric Ceiling Fans.

28333.—1909. P. S. SWAN, Calcutta. A stationary spindle is secured to the motor carcase. A rotary sleeve mounted on the spindle carries the armature, the commutator and the fan spider. An adjustable end thrust ball bearing supports the sleeve. A lubricant receptacle is secured to the lower end of the spindle. When the motor is running the lubricant flows upwards and is retained in a chamber at the upper end of the sleeve. When the motor is stopped the lubricant works its way down again.

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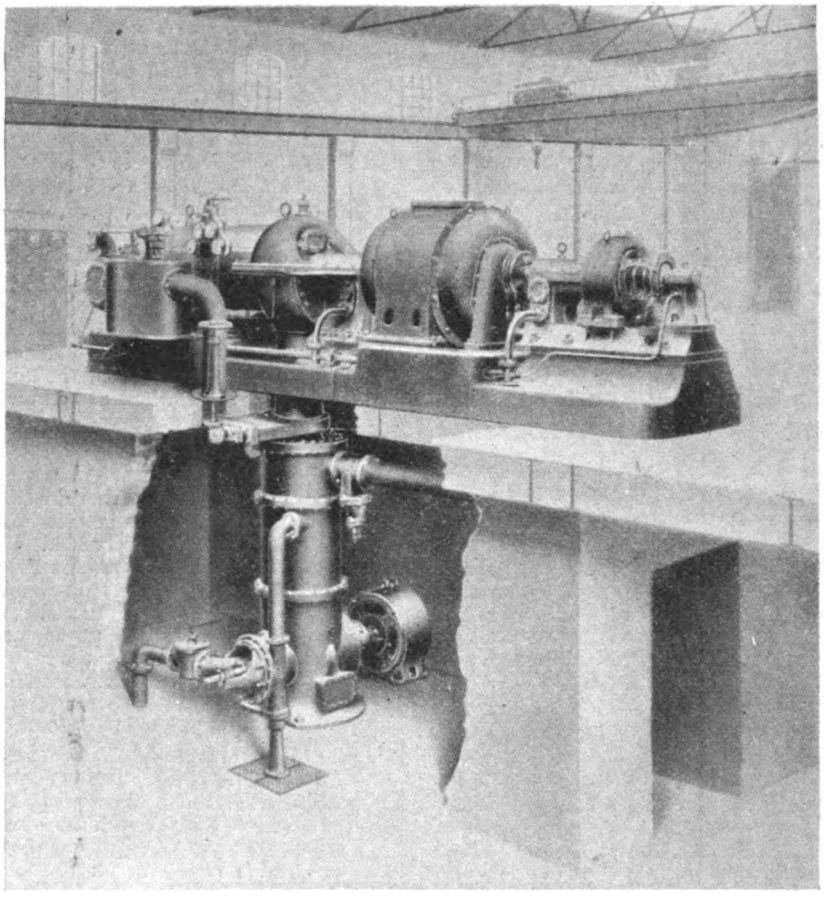
PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

Leblanc Air Pump and Condensing Plant.

Soon after the steam turbine became a commercially-practical prime mover, it was realised that, in order to obtain the best possible results, a very high vacuum was necessary. The air pumps then in use were all of the reciprocating type, with pistons, valves, etc. These were perfectly satisfactory for the moderate vacuum required for engine work, but, as their motion was reciprocating their efficiency fell off very rapidly at high vacuum owing to leakage, past valves, and re-vaporation in the pump chambers.

The type of pump required was obviously rotary, and many attempts were made to produce an efficient air pump of this type which would meet the required conditions. Success was slow in coming, but it came at last, when M. Maurice Leblanc began to investigate the subject, and after exhaustive tests and experiments lasting over several years, he evolved the apparatus now known as the Westinghouse Leblanc Condensing Plant, which is being largely exploited by the British Westinghouse Electric and Manufacturing Company.



LEBLANC MULTIPLE-JET CONDENSING PLANT COUPLED TO WESTINGHOUSE-PARSONS TURBO-ALTERNATOR SET.

The distinctive feature of this apparatus is the air pump, which is of the rotary type. It is valveless, and has no waste clearance spaces. In construction it is extremely simple; the floor space occupied is very small; its efficiency is high and the vacuum obtained is within 1 to 1·5 per cent. of the theoretically perfect for turbines. Owing to the absence of rubbing and wearing parts the efficiency is not impaired by long service. The maintenance is negligible as the attention required when running is practically nil, and on account of its simplicity, there is entire freedom from breakdown.

The British Westinghouse Electric and Manufacturing Company, Manchester, make practically every type of condensing plant to operate in conjunction with the Leblanc rotary dry-air pump.

Complete particulars are given in the leaflet No. 451/2A just issued by that company, which describes the operation of Westinghouse Leblanc Condensing Plants working with the Leblanc simple-jet condenser (an improved ejector type); the Leblanc multiple-jet condenser (an improved low-level jet plant in which there is no liability to backflood the engine or turbine exhausting into the condenser); the Leblanc barometric-jet condensing plant and the Leblanc surface condensing plant.

Special attention is drawn to the very high vacuum attainable with the Leblanc dry air pump which compresses the air passing through it and delivering the vapours at the temperature of the sealing water; that is to say, the volumetric efficiency compared with the reciprocating pump is 100 per cent.

This feature permits the circulating water to be reduced so that the temperature of the hot-well discharge may be within 2 degrees Fahrenheit of the temperature corresponding to the vacuum, and in some cases equal to it. The actual volume dealt with by the Leblanc pump increases with the vacuum; with reciprocating pumps, however, the reverse takes place, which necessitates disproportionately large pumps with corresponding increase of power, first cost, and maintenance.

The Leblanc condensing apparatus was introduced on the Continent about five years ago, and there are now nearly 2,000 sets of this type in operation or on order.

It was not until three years later that the apparatus was introduced to the British market, and over 100 sets have already been supplied. They are installed with all types of engines: high-speed and low-speed, including colliery winding engines, rolling-mill engines, and turbines, and the results in every case have been entirely satisfactory.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
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NOTES.

Prices and Profits.

Mr. T. Harding Churton's inaugural address to the Yorkshire Local Section of the Institution of Electrical Engineers on Wednesday was not altogether lively, for he saw no immediate improvement in prices, though the demand for machinery was increasing. But when he came to discuss the questions of manufacturing methods and costs his remarks were of a more constructive character. He pointed out that many causes have contributed to the general lowering of costs of production—which in some branches of manufacture have been very marked—in spite of a concurrent increase in prices of some of the chief materials. Improvements in design that have resulted in the more economical use of material, to which I have already alluded, is one of these causes. Another is that the manufacture of most machines or apparatus has been reduced to a series of simple operations, requiring less, but more specialised, skill and knowledge on the part of the workman, and effecting a considerable saving in time. As an instance of this, compare the old smooth-core, hand-wound drum-armature, that required considerable skill of the "armature-winder," with the present-day toothed-core, former-wound armature, the "winding" of which consists in placing ready-made coils into slots with ready-made insulating linings—the coils themselves being made either by machine or by hand on formers—a series of simple processes that require comparatively little skill or judgment on the part of the workman, little, in fact, beyond the exercise of ordinary care in manipulation. On the whole, Mr. Churton was rather inclined to advocate specialising, because a factory run with the purpose of turning out one or two appliances could be organised on a cheaper basis. But this is a big question. So far the general tendency with us is for firms to take up new lines rather than to restrict their activities to one or a few grooves.

Insulation.

While pointing out the considerable advance made in the insulation of certain appliances—for instance, transformers and the insulation of windings, Mr. Churton laid emphasis on the necessity for greater attention to this branch of science. Most people will agree with him that the important object of insulating materials is one affording ample opportunity for research and experiment. The dielectric strength of various materials at different temperatures is easily determined; what is required is more information as to the effect of maintaining various materials, say, the cotton covering of copper wire, at certain high temperatures for a given time and repeated many times—reproducing as far as practicable the conditions of service—and comparisons of the effect upon samples treated with various compounds used as varnishes.

Electric Light and Workmen's Dwellings.

The Eccles experiences, reported fully in our issue of the 4th inst., have called forth some interesting comments. Mr. Charles D. Taite, of the Lancashire Electric Power Company, writes that if electricity is charged at not more than 4d. per unit, a workman's home ought to be lighted at much less than 6d. per week. He assumes that two out of the six 16 c.p. lamps would be in general use, at an average of 750 hours, and the total of 1,500 lamp hours at 4d. a unit would work out at 8s. 4d. per annum. This is partly confirmed by Edinburgh's experience. Mr. Frank Newington, taking 500 local small tenement houses, finds that in 60 cases the annual bill for electricity was under 15s., in 80 under 17s., in 75 under 19s., in 89 under 21s. 6d., in 65 under 24s., and in 160 under 30s. Thus in 60 houses the weekly bill works out at less than 3½d. In all these cases from six to nine lamps, of from 8 to 16 c.p., are used.

Municipal Wiring.

A case of considerable importance to electric lighting undertakings—presumably company as well as municipal—was decided in the Rochester County Court. The Gillingham Town Council, acting as the lighting authority, sued a former customer of their's for £10 0s. 2d. for electric light fittings. It appears that the Town Council's electricity department wired the defendant's house and supplied lamps, under an agreement to the effect that the agreed cost, £13 6s. 2d., should be paid off at the rate of £1 2s. 2d. per quarter for three years. It was agreed that the wires and fittings should remain the property of the corporation until they were paid for in full, when they became the property of the consumer. But it was also agreed that if the tenant left the house the balance of cost became due, the consumer not having the privilege of making over the benefit of his contract to a new tenant without the approval of the corporation. In this case the consumer gave notice to the Lighting Department that he was leaving, and he paid two quarters, and also the full amount due for current consumed. But he did not pay the balance on the wiring contract. It appears that the premises were taken for short periods by two different tenants after the original consumer left, and in each case the electricity undertaking supplied current, using the house wires. The judge held that there was resumption of possession, non-suiting the plaintiffs and allowing defendant costs.

Electrically-Driven Jute Presses.

Jute merchants in India are now turning their attention seriously to electricity for the purpose of working their presses. Of course, this method of driving entails very considerable economy, as power is only used for actual work, while with steam driving there is necessarily a large amount of waste. Mr. H. R. Speyer, A.M.I.E.E., Chief Engineer in India for the Lahmeyer house, has been instrumental in installing electric drives for the Andrew Yule & Company's jute presses at Calcutta, and for the Hooghly Hydraulic Jute Press. Considerable extensions are foreshadowed.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION.—The annual smoking concert will be held at the Holborn Restaurant (Council Room) on Friday, November 18, at 8 for 8.30 p.m. Mr. Reginald S. Downe, M.I.E.E. (President), will take the chair, and advantage will be taken of this occasion to make a presentation to Mr. Howard Foulds, the late honorary secretary of the Association.

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THE ELECTRIC VEHICLE.

Why Does England Lag Behind the United States?

By SPENSER SARLE.

Mr. A. Hugh Seabrook, the general manager of the Borough of St. Marylebone Electric Supply, in a letter to the ELECTRICAL ENGINEER, draws attention to the remarkable progress made by the electric vehicle industry in the United States, as evidenced by the amount of publicity accorded by the technical journals of that country to the recent meeting in New York of the Electric Vehicle Association of America; and adds the caustic comment: "We are ahead, and well ahead, in electric vehicles in this country, are we not?"

We can well understand that English electrical engineers regard it as an amazing circumstance that so little progress has been made in this country in respect of this particular branch of electrical development. Readers of the ELECTRICAL ENGINEER will not need to be reminded that for nearly a year and a half in the Electrical Progress section of that journal its New York Correspondent has almost every week had something noteworthy to record in respect of American activities in this direction. Far keener, apparently, than the bulk of their English brethren to realise the possibilities of the electric vehicle, electrical engineers in the United States have for years past been devoting their energies to the perfection of this type of vehicle, both for social and for commercial purposes, and the result is the evolution of cars and wagons which are so rapidly growing in popularity that whereas two years ago in certain big American cities there was only one of this type of vehicle to every forty of the petrol-driven type, there are now ten to every forty. In the matter of comfort, cleanliness, simplicity and absolute freedom from danger, the electric car and the electric wagon are a whole generation ahead of the petrol-driven vehicle. In regard to initial cost and upkeep the comparison is also in favour of electricity. Whence, then, comes the sluggishness of the English manufacturer? Why should the petrol car be allowed to have everything its own way?

The manufacturers' reply to this question is that in this country there is little or no demand for the electric car, superior to its petrol rival though it may be; and the reason for this lack of inquiry lies in part at the door of the Central Station manager, who is in no hurry to offer at a reasonable rate the facilities which the electric car owner desires; and in part at the door of that prejudice in the public mind which is based on the mistaken notion that the electric car is heavy, costly and uncertain in its operation; while the process of renewing the driving energy is tedious and complicated. In all this there is undoubtedly a substratum of truth, and the circumstance that it is no one's business in particular to sift out truth from error has been fruitful in bringing about many misapprehensions, not the least of which is that the storage battery is still little more than a toy. Dealing with this particular point last week, the New York Correspondent of the ELECTRICAL ENGINEER quoted (page 532) an account of some electric vehicle performances, which was submitted to the meeting to which Mr. Seabrook refers. In one of these trials—not made with specially selected cars—85 to 100 miles per day were covered on a single charge of the Edison battery. In another an Anderson (Detroit) car accomplished on a single charge a run of 84 miles at an average of over 12 miles per hour over freshly tarred roads with grades as high as nine per cent., after which the excess battery capacity showed a surplus of 18 miles, giving 102 miles for a single charge; a Bailey car ran 76 miles at an average of 13·19 miles per hour, and the battery showed a surplus of 40 miles, giving a total capacity of 116 miles on a single charge. Other cars gave records of over 122 miles at 12·38 miles per hour; 139½ miles at 13·71 miles per hour, and 113 miles at 12·47 miles per hour. In another case an electric car was run for 90 minutes per day for seven days under a sealed charging socket, and at the end of the test the odometer showed 120 miles at an average of 12·32 miles per hour at a total cost of $1.42 cents, or, say, six shillings sterling. The hill trials included an ascent of 2,138 feet at a grade of 11 per cent., and 21 successful trips up the hill were made on a single charge.

Dealing with this particular branch of the subject in connection with the meeting of the Electrical Vehicle Association of America, the "Electrical World" observes editorially that few people appreciate the large number of electric vehicles in operation to-day, the greatest strides having come within the past year or two from improvements in the electric storage battery. "In view of the advantages of the electric vehicle, it is, however," proceeds the writer, "astonishing that the public has been so lax in its appreciation. The utilitarian features of the electric vehicle and its superior practicability and economy may have to be proclaimed from the housetops ere much impression is made, and the fund already available for publicity work can be profitably employed in this cause. It is refreshing to note the bright spots presented by those cities where the electrics have established themselves in large numbers through intelligent exploitation of their merits. The examples cited indicate what can be done elsewhere also by similar zealous work on the part of those vitally interested in the sale and upkeep of the vehicles. Battery makers offer encouragement in the shape of improved cells, and the need of lighter eletcric delivery wagons voiced by central stations will no doubt be heeded by vehicle manufacturers. Taken all in all, the outlook is cheerful. There is much, however, which remains to be taught, but happily there is a growing disposition on the part of prospective users to look into the advantages and economies of the electric vehicle." We wish that as much could truthfully be said on this side of the Atlantic.

With regard to the popularisation of the electric vehicle, some very practical hints were given in a paper read before the Electrical Vehicle and Central Station Association at Boston last month by Mr. E. S. Mansfield, of the Edison Illuminating Company. He urged that at least one garage should be established in every city and town where electrics are in use, or where they could be sold if a garage were installed, and that an efficient inspector should be appointed to see that electric garages give the best of service, to inspect batteries in private charging stations and to educate the caretakers in the simple rules of battery charging. A standard form of charging plug should be adopted, and also an official form of charging sign. An official list of charging stations should be compiled and corrected from time to time, and be available for distribution to electric vehicle owners and prospects. A committee should be appointed for the purpose of standardising terms and usages, and also forms of records for public and private garages Concerning central-station rates, he urged that the prospective customer must not take it for granted that rates for charging are so high that he cannot afford to buy an electric, as a talk with the company's agent may prove to him that the rates, in fact, are particularly attractive: and he must also understand that the cost of current is a small item compared with the greater saving in the use of electric vehicles.

Speaking at another electrical gathering at Boston, on another branch of the subject, Mr. Mansfield pointed out in connection with commercial electrics that where the same use is made of the gasoline and electric vehicle the latter shows a decided advantage, both in maintenance and operation. There is a considerable saving in tyre maintenance of the electric over gasoline vehicles, owing to the better acceleration of the electric, and the electric through its ideal control gives an appreciable saving of time in congested districts, while its life is from two to three times that of the gasoline machine, due to quiet running and lack of vibration. No extra rate of insurance is imposed on the electric, or on the building or shed where it is housed, and it is admitted to railroad depots and freight yards and on steamboat docks, from which the gasoline truck is excluded. An instance was cited of a 1,000 lb. electric wagon's operation during a period of four years, which had a repair account amounting to exactly 30 cents, aside

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from the case of a spring broken in passing over a bad piece of road.

[We venture to commend these points to the attention of manufacturers, electrical engineers and central station managers in this country. In a further article we hope to deal with some important points in connection with the storage battery question and cognate subjects; and in the meanwhile we have pleasure in inviting correspondence as to the most effective means of popularising the electric vehicle in this country.—ED. ELECTRICAL ENGINEER.]

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

Programme of Centre Meetings, Session, 1910-11.

METROPOLITAN CENTRE.—1910.—Dec. 12: "Life and Behaviour of Primary Batteries Used for Telephone Purposes," J. G. Lucas.

1911.—Jan. 9: "Testing Paper Core Underground Cables during Construction," L. J. Sell; Feb. 13: "Conveying Systems," E. W. Pettit; March 13: "Principles and Methods of Using Small Power Engines," H. R. Rivers Moore; April 24: General annual meeting.

EASTERN CENTRE.—1910.—Nov. †: Opening addresses, J. F. Lamb; Nov. 29: "Unit Maintenance Cost System," R. J. S. Gold; Dec. †: "Central Battery System of Telephony," T. Cobbe.

1911.—Jan. †: "The Training of a Lineman," E. T. Titterington; Feb. †: "Paper Core Cable Faults, their Localisation and Removal," A. R. Nichols; March †: "A Few Notes on Road-making, Repairs, etc.," A. Evans.

MIDLAND CENTRE.—1910.—Nov. 30: "Unit Maintenance Cost System," R. J. S. Gold; †, "Modern Telephone Systems," J. G. Hill; †, "Internal Wiring and Cabling of Offices," W. E. Twells. A Paper by Mr. Cave Brown Cave has also been promised.

NORTH-EASTERN CENTRE.—1910.—Nov. 28: "Unit Maintenance Cost System," R. J. S. Gold; Dec. 19: *, T. E. Herbert.

1911.—Jan. 16: Annual meeting; Feb. 13: "Office Organisation," G. H. Hoole; March 13: "Maintenance and Duties," J. D. Taylor.

NORTHERN CENTRE.—1910.—Nov. 14: "Some Points in Open Line Construction," T. B. Johnson; Dec. 12: "Aerial Cables," J. McKenzie.

1911.—Jan. 16: "Organisation," J. R. Andrews; Feb. 14: "Telephoning of Small Towns," T. Patterson; March 14: "Notes on Building Construction," H. Kitchen.

NORTH-WESTERN CENTRE.—1910.—Nov. 7: "Wireless Telegraphy," A. C. Timmis; Dec. 5: "Unit Maintenance Cost System," R. J. S. Gold.

1911.—Jan. 9: "Selenium: Photo-Electric Effects and Photo-Telegraphy," W. B. Smith; Feb. 6: "The Maintenance of Trunk Sections in Primary Battery Exchanges," G. Bowyer; March 6: "The Clerical Work of a Sectional Engineer's Office," S. C. Leggett and A. Rowbotham.

NORTH WALES CENTRE.—1910.—Nov. 16: "Section Stocks," T. Adams; Dec. 8: "Unit Maintenance Cost System," R. J. S. Gold.

1911.—Jan. 10: "Underground Construction." J. Crane; Feb. 8: "Methods of Statistics," A. S. Renshaw; March 16: "Contractor's Accounts," T. Plummer; April 12: "Notes on Building Materials," F. Horner. Visits will be arranged to: Seaforth Wireless Station, Lever's (Port Sunlight), Railway Signal Works, Fazackerly.

SOUTH WALES CENTRE.—1910.—Nov. 8: "First-Aid: Its Aims and Objects," Sergeant D. J. Francis (Superintendent of the Police Division of the St. John Ambulance Brigade); Visit to the Engineering Shops of the University College of South Wales and Monmouthshire, conducted by Professor A. C. Elliott; Dec. 13: "Sound, Light, and Heat" (Illustrated by Lantern Slides), J. H. M. Wakefield.

1911.—Jan. 10: "Circulars E. 11 and 12," a discussion to be opened by H. G. Tissington; Feb. 14: "Secondary Cells," C. M. Herbert; March 14: "Short Submarine Cable Across Docks and Rivers" (illustrated by Lantern Slides), H. Cranage; Visit to Ebbw Vale Company's Works.

SOUTH-WESTERN CENTRE.—1910.—Nov. 14: "Unit Maintenance Cost System," R. J. S. Gold. Particulars of other meetings not yet available.

SCOTLAND EAST CENTRE.—1910.—Nov. 9: "Slide Rule," James Patrick; Nov. 30: "Training of Linemen," B. J. Gill; Dec. 14: "General Submarine Work," F. H. Machugh.

1911.—Jan. 11: "Construction of Heavy Main Lines," John Patrick; Feb. 8: *, C. Crompton; March 8: "Notes on Aberdeen Underground," E. Slader; March 29: *, C. J. Mercer; April 19: "Leading-in Arrangements at Edinburgh H.P.O.," J. McIntyre.

INSTITUTION OF ELECTRICAL ENGINEERS.

Students' Section.

The opening meeting of the Students' Section will take place on Wednesday, November 16, in the Lecture Theatre of the Institution, Victoria-embankment, W.C., at 7.45 p.m. An address will be given by Mr. C. H. Wordingham, M.I.E.E.

All students of electrical engineering are invited to attend this meeting, whether members of the Students' Section or not. Gentlemen desirous of attending, who are not members, are requested to send their names to the Hon. Secretary (address below), not later than Tuesday, November 8.

Programme for the Session 1910–1911.

Meetings will be held in the Lecture Theatre of the Institution, Victoria-embankment, W.C. They will commence at 7.45 p.m.

1910.

Nov. 30.—J. C. Rennie: Tramway Brakes and Break-gear.
Dec. 14.—J. F. Shipley: Progress in Arc-lamps.

1911.

Jan. 19.—P. R. Coursey: Wireless Telegraphy, with special reference to "Short-spark" Methods.
Feb. 1.—H. Clark: Telephony.
„ 15.—H. C. Mary: Dry-core Lead-covered Telephone Cables.
March 15.—R. C. Plowman: Exhaust Steam Turbines.
April 12.—J. M. Bloomfield: Overhead Lines for Transmission of High-Tension Electrical Energy.
„ 26.—J. B. Sparks: Electric Traction for Main Line Railways.
May 3.—ANNUAL GENERAL MEETING. ELECTION OF OFFICERS AND COMMITTEE FOR SESSION 1911–1912.
„ 3.—A. E. E. Cheal: Some New Zealand Electric Plants.

No programme of visits has been arranged, but suggestions with regard to visits are invited, and should be sent to the Hon. Secretary, D. BETTS, 3, Fordwych-road, London, N.W.

PERSONAL.

As a result of the alterations subsequent to the last Dundee municipal election, Mr. W. Don retires from office as Chairman of the Electricity Committee, having been re-appointed a magistrate. Mr. Don has been of great service to electrical interests, and the result of his influence has been shown in the rapid strides taken by his department since he first became chairman. He is succeeded by Mr. J. M. Nairn, who also has had considerable experience on the Electricity Committee.

On the occasion of his marriage (which took place on Monday), Mr. H. P. Baynham, Chief Assistant Engineer, Whitehaven Corporation Electricity Works, was presented by the staff and workmen with a handsome marble clock and pair of bronzes. The Borough Electrical Engineer, Mr. B. Sankey, in making the presentation referred to the esteem and respect in which Mr. Baynham was held by all, and conveyed to him and his wife the good wishes of all for their future welfare. Mr. Baynham, in acknowledging the gift, testified to the pleasant years spent amongst them, and the cordial and loyal relations which existed between all alike.

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INSTITUTION OF ELECTRICAL ENGINEERS.

Inaugural Address.

By S. Z. de Ferranti, President.

Judging from the opening meeting—and, incidentally, the opening of the new building—things augur well for the 1910-11 Session. The spacious theatre of the new building was packed, and a very large part of the electrical profession must have been present. There were also a generous sprinkling of ladies, among whom was Mrs. J. H. Rider, who received the premium awarded to her husband in his absence in Africa.

Dr. GISBERT KAPP, the retiring President, in opening the meeting, said that the present was an historic occasion, as it was the first meeting in the new home. The Council hoped to celebrate the important change in a fitting manner at a later date. For 38 years they had enjoyed the hospitality of the Institution of Civil Engineers, but the growing importance of the electrical profession and the growing membership had made it necessary to acquire a home of their own. He considered that they were greatly indebted to the Institution of Civil Engineers for their great hospitality, and they could not commence their proceedings in a better way than by passing a hearty vote of thanks to the Institution.

This was carried with acclamation.

He then called upon Col. Crompton to make a statement on the labours of the International Electrotechnical Commission.

Col. R. E. CROMPTON said that the first use the new building was put to after being acquired by the Institution was to hold the first meeting in England of the Electrotechnical Commission. During the time that had elapsed since the question of international interchange of electrical ideas matters had gone on apace, and now 16 leading countries in the world had formed their own Commissions. As was well known, the English Institution of Electrical Engineers took a leading part, and the first conference held was in the Institution's new home. The second one was held in Brussels, and he had been asked to make a statement as to what took place there. He thought it best to merely repeat the words of the president of the Commission, Elihu Thompson, who said "that no work of such huge importance to the electrical industry had exceeded that commenced during the last few years with the international interchange of electrical ideas." It was very difficult to carry on such matters, as there were many jealousies and susceptibilities to be overcome, but the progress already made was something to be proud of. The objects of the Commission were, firstly, a practical international language of electricity, secondly, to standardise machinery, and thirdly, to standardise symbols. They were bold to attack such work.

The president distributed the premiums and scholarships to the successful authors, and then called upon Mr. S. Z. de Ferranti to occupy the presidential chair vacated by Dr. Kapp.

Col. CROMPTON said that it was with the keenest pleasure that he proposed that a vote of thanks be passed to the retiring president, as he probably had the longest electrical acquaintance with Dr. Kapp than anyone present. Dr. Kapp came to him when he was not an electrical engineer, and they all knew what he had become since. Col. Crompton thought it a wonderful thing that they should have secured as their president a man who had had one complete electrical training in England and another in Germany, and then came back to England again. It said a good deal for the attractions of this country.

Mr. W. M. MORDEY (a past-president) seconded the motion, wishing Dr. Kapp health and success, and what he knew Dr. Kapp would value most, strength and energy to continue his good work.

This was carried with acclamation.

Dr. G. KAPP, in thanking the members for their kind vote, said that it was peculiarly gratifying to him that it should have been Col. Crompton who had moved the motion, as Col. Crompton was the man who taught him.

Mr. S. Z. de Ferranti then read his Presidential Address, an abstract of which will be found below :—

Mr. Ferranti said : I propose this evening to address you on the following subjects :—(1) Coal Conservation, (2) Home Grown Food, and (3) The Better Utilisation of Our Labour, for these problems are closely connected and are all capable in a great measure of being solved by means of an electrical treatment.

There are few subjects more important to the people of this country than the question of the rapid and ever-growing rate at which we are using up our coal supplies. It may be said that the rate at which we can use coal is a measure of our industrial activity and prosperity. This would be true, perhaps, if we were using our coal without waste, or at least with reasonable economy, but it is certainly not true of what we are at present doing. Taking all the uses of coal into consideration, I believe that we are getting back an amount represented by useful work of one kind or another of much less than 10% of the energy in the coal. We can never, of course, hope to get anything like the full value of the energy in the coal, but, on the other hand, throwing away more than 90% of the value of our coal in the process of conversion is of the greatest possible concern to the country. Moreover, we now dissipate nearly the whole of the valuable by-products contained in the coal, consisting principally of fixed nitrogen. Besides the question of the waste of our coal by misuse, there is another cause working at an ever-increasing rate towards the exhaustion of our supplies. I refer to the immense exportation of our coal to other countries.

I will now turn to the question of our food supplies, and without going into details, which are available for every one to read and study, I would remind you that we now import the greater portion of our food because we believe it pays us better to do so.

This state of affairs is brought about by a number of complex circumstances, but is, in a measure, due to the necessary uncertainty of prices in our market under our present system, the comparatively small acreage that we have available, and to getting an insufficient return from the land that we have under cultivation.

Our only chance of supplying our food requirements lies in a successful system of intensive cultivation throughout the country. This, in its turn, depends upon many things, but primarily it can be stated that it involves spending money in order to get the greater return required, and our farmers are naturally averse to spending money when the return to be obtained is so problematical. It is also attributable to the fact of intensive cultivation requiring a liberal supply of chemical fertiliser for the land, principally in the form of fixed nitrogen. This commodity, on account of the wasteful system of using our coal, is, I believe, at too high a price to make intensive cultivation attractive to the farmer.

There is a further difficulty still standing in the way, viz., the want of knowledge on the subject of intensive cultivation, but I am sure that once a sufficiently general interest was felt in the country, and a sufficient prospect of reward to workers on this subject assured, that knowledge would grow at a rapid rate and soon bring about an efficient system of using our land to the best advantage.

The third subject that I have mentioned to you is that of our wasted labour. It may be said that all labour is useful insomuch as, if it were not required it would not be used. On the other hand, we may consider the theoretical case of all labour being wasted insomuch as it is possible to conceive of a vast automatic machine which, with the direction of a single person, would fill all our possible requirements and would include in its many functions a capacity for keeping itself in repair, and extending its operations to all new wants that it had to fill. There is, however, as in most things, the middle course for which we should aim, and that is, the supply of all our reasonable wants with the least possible amount of labour.

Looking at the question more in detail, we can first consider the labour spent in and about raising and distributing the coal which we now use, and which we would save under more economical conditions. Then there is the vast army of workers who are employed in cleaning up the dirt that is produced by our present methods of using coal. If you consider what goes on in every household you will see how large a proportion of the domestic labour is devoted to this. There are also all the people who are now employed in the process of burning coal for all the various uses to which it is put and who represent an enormous amount of

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labour which, under a more efficient system, could be turned to better account in the interests of the country.

It must be evident that the more efficient running of the country as a whole the more rapidly must it add to its wealth and diminish the amount of labour which individuals have to expend in order to live at a given standard. This efficient working of the country to a large extent depends upon the proper use of its natural resources in the form of material and labour, and the saving of all waste in both of these which can possibly be brought about. Considering the question of coal saving, by-product recovery, and labour saving, it is evident that the only way of obtaining material improvement under these heads is to concentrate the process of transformation of the coal and to carry out this process at the smallest reasonable number of centres. It is in the process of transformation of coal into work in the form of heat and power that the great loss occurs, as this is always a most difficult process and requires the highest scientific and practical skill to carry out with even very moderate economy. It has been proposed, with a view to accomplishing the above ends, to treat the coal at central stations and turn it into gas and distribute the energy in this form, but this process only goes a small way towards a solution of the problem, as under it, combustion —which is such a difficult problem—would be taking place at numerous points over the whole country, all tending to inefficiency, and the conversion of the gas into power is by no means easy, involving running machinery of the reciprocating class, requiring special and skilled attendance.

It appears that, with a problem such as we are discussing it is fundamental that the energy in the coal should be converted at as few centres as possible into a form in which it is most generally applicable to all purposes without exception, and in which it is most easily applied to all our wants, and is, at the same time, in a form in which it is most difficult to waste or use improperly.

We are, therefore, forced to the conclusion that the only complete and final solution of the question is to be obtained by the conversion of the whole of the coal which we use for heat and power into electricity, and the recovery of its by-products at a comparatively small number of great electricity producing stations. All our wants in the way of light, power, heat, and chemical action would then be met by a supply of electricity distributed all over the country.

It must, however, be remembered that the distribution of energy in the form of electricity instead of coal can only be effectively carried out when it can be done in such a way that it is available for all the purposes for which coal is now used, and this can only be the case when the conversion is effected at such an efficiency as will cause the electric energy delivered to represent a high percentage of the energy in the coal. Failing this no scheme for conversion at the pit's mouth and delivery of energy in the form of electricity is sound. There is also another controlling factor which must be satisfied in order to make this scheme possible. Both the conversion of the coal into electricity and the distribution of the current must be effected at a low capital cost so as not to overburden the undertaking with capital charges.

Considering the various processes of conversion which are now available, or which may be invented, and their possible and probable efficiency, we first come to electric generators driven by reciprocating steam engines. Their economy, expressed in the form of energy in the coal to electric energy, may be taken as a maximum of 10 to 12%. This is, of course, far too low an efficiency to make any scheme such as I have already indicated possible, besides which the capital expenditure and the complication involved are far too great and the size of the units too small to be thought of for the purpose in view. We next come to large steam turbines such as have been constructed up to the present, and see that their maximum efficiency may be put down at about 17 to 18%. Next in the list, in order of economy, comes the big gas engine fed from gas producers, with an efficiency of coal energy to electric energy of possibly 25%.

In the future we have to look towards two other means of conversion—the gas-turbine-driven electric generator and the production of electricity in some more direct way from the coal, but these two means of conversion, although being capable of giving the most efficient results, are so much in the distance, that they are quite beyond our present consideration.

After very careful thought on the subject I have come to the conclusion that, in order to supply electricity for all purposes it would be necessary, amongst other things, to have a conversion efficiency of not less than 25%.

For the purpose of looking into this question I have taken the figures of production and consumption given in the Report of the Royal Commission on Coal. According to this report 167 million tons of coal were being used in the country in 1903. Of this amount 2 million tons went to coasting steamers and 15 million tons were used by the gas companies. In order to simplify matters, and make the figures clear, I have left out of consideration the coal used on these two items, and taken the balance—viz., 150 million tons—as the annual coal consumption of the country. If now, instead of using this coal for doing work as at present, we were to convert it into electricity, we should use, instead of 150 million tons, 60 million tons of coal a year. This coal, turned into electricity, would produce 131,400 million Board of Trade units, and the electricity so produced would, after allowing for losses of transmission and conversion into work of different kinds, be sufficient to supply the whole of our requirements now being satisfied by the use of the 150 million tons of coal which we now burn.

In the conversion of coal into electricity one of the most important considerations is the load factor at which the converting and distributing plant effects the operation. Electricity used for lighting, cooking, power, and traction must be supplied as and when required. On the other hand, domestic heating will be done largely through the medium of heat storage, and is therefore a controllable form of demand. Metallurgical and chemical processes, which depend for their success upon a very cheap supply of current, will have to be so adapted and modified that they can take current intermittently and so fill up the load curve, thus enabling the current which they require to be produced with the least capital expenditure and at the same time greatly assisting the good conversion efficiency of the whole supply. I believe that under the circumstances a load factor of 60% would be obtained.

Considering now the means to be adopted for converting the coal into electricity, and the efficiency at which this can be done, we find that in gas-engine-driven alternators we have a system theoretically capable of returning 25% of the energy in the coal in the form of electricity, and from this point of view they would meet our requirements.

The gas engine, however, as a converter of energy on the scale required suffers from the fact that the units are too small and the cost of the complete installation is too high. These difficulties appear to defer the realisation of an all-electric scheme until electricity is generated by some gas turbine of the future, or direct from coal by chemical action.

There is, however, an intermediate process of conversion which will, I believe, give the necessary efficiency without undue complication or expense. The steam-gas turbine in which steam is used in the state of a gas at a high temperature throughout the process of conversion into work, gives theoretically a high efficiency at workable temperatures, and I believe will, in course of time, supply the necessary means of conversion for effectively turning our coal into electricity. I have therefore considered the case on these lines.

In order to produce the supply of 131,400 million Board of Trade units at a 60% load factor, machinery of the normal capacity of 25 million kilowatts would have to be installed. For the purpose of estimation, it may be considered that this capacity would be divided up into 100 stations of the capacity of a quarter of a million kilowatts. Each of these stations would contain 10 generators of 25,000 kw. capacity. These stations would be spread about the country to supply the demand in each part, roughly, proportional to the coal now consumed. The positions of the actual generating stations would be largely controlled by the facilities for obtaining coal and water for condensing. In many cases they would be close to the colliery districts, and the current would be transmitted to the points of demand. In other cases, where a considerable demand was concentrated at a distance from the sources of coal supply, and where the coal could be cheaply carried

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—especially by water—stations would be installed and would supply electricity to meet the surrounding demand. In all cases, however, whether far from, or near to the coal production, the coal would be delivered in very large quantities to only a few points of consumption, and would thus reduce the labour and cost of transmission and handling to the lowest figure.

Many works taking a large quantity of electricity for metallurgical and chemical purposes at a very low price would be built adjoining the generating stations, and other existing works would be at such short distances that the capital costs for distribution of the electricity which they used would be very small.

Estimating on the basis of the typical generating station considered and multiplying by the number of stations, I have put down the capital cost of generating works at £7 per kilowatt, which, for the total kilowatts required, gives an expenditure of 175 millions sterling. The cost involved in the distribution system on such a scale is difficult to estimate. The conditions of demand in relation to the position of the supply stations would, however, be favourable, as a great deal of the energy required would be transmitted only short distances, and units of demand would be large. Under the circumstances, I believe that £13 per kilowatt would be amply sufficient, and a sum of 325 millions sterling would thus cover the cost of the distribution system. The total cost of the scheme, including all expenses up to the point of delivering the electric supply to the consumer, would thus be 500 millions sterling. This, of course, is a very large figure, but, considered in relation to other industries and the results to be accomplished, cannot be considered excessive.

It has been estimated that the capital now invested in this country in electrical undertakings amounts to some 400 millions sterling. Last year the Electric Supply Business had invested in it some 58 millions sterling. The proposed scheme would, therefore, absorb from eight to nine times the amount of capital now invested in the portion of electric supply undertakings for which figures are available. The units generated upon the all-electric method of working would, however, be some 150 times as great as those generated by the above undertakings, and the cost of production and sale price of current would, of course, be very much lower than at present.

The cost of producing the electricity required under the scheme may now be considered. Capital costs taken at 8½% upon the money invested, form by far the most serious item, and amount to 0·0776d. per unit, or a total of £42,500,000 per annum. The works costs would, I believe, not exceed 0·036d., bringing up the total costs, including interest and all other charges, to 0·1145d. per unit, or 62 millions sterling per annum. In arriving at the above figures for the costs of generation, 60 million tons has been taken as the annual coal consumption, and this has been charged at an average price of 10s. per ton, thus amounting to 30 millions sterling. On the other hand, it has been assumed that with improved processes of conversion, one ton of coal will yield fixed nitrogen equivalent to one cwt. of sulphate of ammonia. The present price of this commodity is well over £12 a ton, but considering the large scale of production and the necessity of supplying it at a low price to make its use general for agricultural purposes, I have reckoned the fixed nitrogen as of a value of only £8 per ton of sulphate of ammonia, or, on the three million tons to be produced, of 24 million pounds sterling. This reduces the cost of the coal to six millions sterling, which largely accounts for the low works costs.

The cost of chemicals required to make the fixed nitrogen available, together with the necessary labour involved in the process, would be met by the sale of the other coal by-products—principally consisting of tar and oils.

It is, of course, well known that firing by means of gas compares unfavourably with using the coal direct. It is also generally found that a good return of fixed nitrogen in the form of ammonia is only obtained from the coal at a sacrifice of thermal efficiency, and also involves a much smaller yield of the other by-products which can be extracted from the coal, but now that the importance of these matters is realised a great deal of work is being done to improve the processes, and eventually it will undoubtedly be possible to obtain the high return that I have spoken of without sacrifice in other directions.

Following upon the costs of electric generation already discussed, I have assumed, for the purpose of comparison, that the average price at which current would be supplied throughout the country would be ⅛d. per Board of Trade unit. The charges would not be uniform, but would be graded according to the position and nature of the load supplied.

It is interesting for a moment to consider the effect of such a supply of electricity upon its present and future uses. Taking lighting to begin with, which was the first application for which a supply of electricity was generally given, it will be clear, considering the strong position which electric lighting now holds even with current at an average price of 2d. per Board of Trade unit, that when it is obtained from current at the much lower prices that would rule under the all-electric scheme, no other form of light would have a chance in competing with it. Notwithstanding present high prices, a good deal of electric cooking and heating is already being used, and although it would appear to be too expensive for general application, still the very good results obtained and the large amount of labour saved is already sufficient to justify its use to-day. When electric heating and cooking are carried on with current at the very low figures at which it would be possible to sell for these purposes, it would only be a matter of time for all heating and cooking to be done by means of electricity.

Regarding the supply of power, electricity is now admittedly the most convenient form of power for all purposes, and this, again, notwithstanding the costs involved on the comparatively small scale on which we now produce. The overwhelming advantages of electric power at a price at which it would be supplied on the all-electric scheme would clearly ensure its use for all power purposes.

The case with regard to electric tramways and light railways is well-known, and any reduction in the costs of running due to cheaper current would, of course, act greatly in favour of these undertakings, and would help to extend their usefulness. Light railways, which, for various causes, have made such poor progress, if sensibly dealt with, would greatly benefit by finding a cheap supply of energy available in all parts of the country.

The electrification of main-line railways has not yet progressed very far, as it is hard to make out a sufficiently strong case to warrant the large expenditure necessary for electrification; but there is little doubt that growing traffic, which necessitates additional works, will be best met by electrification, which will enable a greater return to be obtained from existing lines and works. The electrification of our railways would be greatly assisted and made a more profitable investment if a supply of current at such a figure as we are now considering were available for their working.

The manufacture of pig-iron is, no doubt, quite the most economical use of coal that we now have, but recent work with electric smelting furnaces has shown that it is only necessary to have electric current at a low enough price and for sufficient experience to be obtained to make it more economical to smelt iron electrically than by present methods, and using only sufficient coke to provide the carbon for the purpose of reduction.

It may be taken, from the experiments already made, that when worked on a sufficient scale a quarter of a ton of coke would be required per ton of iron produced, and that four tons of iron would be obtained per kilowatt-year. This would mean that about 0·42 tons of coal would have to be converted into coke and used per ton of iron, together with about 2,200 Board of Trade units, which, at ⅛d. would come to 15s. 3d. per ton of iron. As the electric furnaces would no doubt closely adjoin the generating station, the price named for current would be a very good one. We should thus have a cost for coke and electricity of about 19s. 6d. per ton of iron produced. According to the recent Report of the Royal Commission on Coal, pig-iron, on the average, now requires about two tons of coal per ton of iron produced, and taking this at the same price as coal has been taken for the purpose of electric generation, viz., 10s., this would give 20s. as the cost of fuel per ton of iron produced. It is, however, probable that the production of pig-iron electrically with current supplied to the works would involve less plant and a less upkeep of plant than at present: also a good deal less labour would be required. Improvements in the process brought

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about as the result of experience would, no doubt, further reduce the costs, and would result, in all probability, in a better article at a lower price. We at present produce about 10 million tons of pig-iron. This would, therefore, require 2½ million kilowatts of plant run continuously and producing 22,000 million Board of Trade units annually. In order to get current for this purpose at the lowest price, it would in all probability be found desirable well to insulate the furnaces to avoid heat loss, and for the same reason to have individual furnaces of a very large capacity. It would then be possible to work intermittently and yet with economy, and so use the current taken by the furnaces to fill up the load curve, thus adding to the economy of conversion and reducing the capital expenditure involved in electric plant.

Steel-making electrically is already in extensive use, and even with present facilities for generating the current which the process requires is beginning to make considerable headway. All steel would, of course, be produced electrically as soon as sufficient experience had been gained regarding details and a supply of very cheap current was available. Foundry work in both iron and steel would be most conveniently carried out by means of electric melting. It is already known that the electric furnace gives the best results obtainable for steel castings. The heating of steel for rolling, forging and annealing will be most efficiently carried out electrically as soon as the cheap supply warrants experimenting in this direction. In fact, all furnace work for which coal or gas is now used could, I am convinced, be more satisfactorily done electrically when an abundant and cheap supply is available.

We now use aluminium for a number of purposes, notwithstanding our want of knowledge as to the best ways of working it. When our experience with aluminium in any way approaches what we now know about the working of steel, it is certain that vast quantities of this material will be used throughout the world. The manufacture of aluminium is another of the processes which will be greatly facilitated by a cheap supply of electricity. In fact, it may be said that aluminium can only be produced economically at present in water-power countries, but as an intermittent supply of electricity could be given under the proposed scheme at a lower price than it is being obtained from water-power countries to manufacture this metal.

With cheap electricity available, electro-chemical processes must grow and multiply to an enormous extent, and not only should we produce for ourselves all the chemicals which are now produced electrically abroad, but everything that can be produced electro-chemically would then be made in this country.

There is a further application of the electric current which, so soon as the price was low enough, would, no doubt, largely come into use. This is in the intensive growing of fruit and vegetables under glass. It is known that considerably more forcing in the way of heat can be advantageously applied where light is also furnished artificially, and it is therefore probable that, with electricity everywhere available at a low price, an immense amount of intensive cultivation under glass with the heat supplied by means of the electric arc would be undertaken, as in supplying heat by this means light would also be supplied, which would have the effect of enabling the growth to benefit fully by the artificial heat.

Summarising the whole position, it may safely be said that, wherever coal, gas, or power are now used, everything for which they are used will be better done when electricity is the medium of application.

Hardly less in importance in the all-electric scheme is the question of the by-products which become available by the proper use of our coal. These consist principally of fixed nitrogen, together with tar and oils. Fixed nitrogen in the forms of sulphate of ammonia, nitrate of soda, and nitrate of lime are most valuable fertilisers, and enable land continually to produce the same crops with a greatly increased yield per acre. Much has been done in finding out how best to utilise these artificial fertilisers, but no doubt a great deal more will be done in this direction, and fertilisers will be prepared, with fixed nitrogen as their principal constituent, which best suit the particular soils and crops that it is desired to deal with. According to last year's Board of Trade returns we now grow about 23% of the total wheat that we use and import 77%. Of the barley used we grow 59% and import 41%, and of the oats used 78% is home grown and 22% imported. Last year we devoted 7¾ million acres to the cultivation of these crops. Much is being done to improve the yield of corn crops, and it is probable that with scientific treatment in the production of the seed, in the sterilisation of the ground, and in the application of fertiliser, we may look at no distant date to an increased yield of 50 per cent. in these crops upon what is now being produced per acre. The most vital feature, however, in bringing this about, once we have acquired sufficient knowledge, is an ample supply of fixed nitrogen to use as fertiliser, and it is when considered from this point of view that a scheme which supplies this from our coal as the result of saving present waste is most important. With the increased yields which we have mentioned we could produce corn crops sufficient to supply the whole of our requirements upon 11 million acres. This would represent 23½ per cent. of our present cultivated area, and would only be an addition of 3¼ million acres to the land now used for the purpose of growing these same crops. The value of these additional crops would be about 58 millions sterling, based upon the prices which we paid last year, and to this would have to be added the value of the straw and the other wheat by-products, which would go a long way towards providing the food for growing the additional meat which we require to supply our demand at home.

In order to fertilise the land, we should have available under the all-electric scheme, 3 million tons, or its nitrogen equivalent, of sulphate of ammonia. This, if used over the whole of the 46¾ million acres now under cultivation, would give 143 lbs. per acre, but, of course, the fertiliser would be distributed according to the nature of the land and the crops being grown. It is probable that under these circumstances the increased yield of the land now cultivated would not only give us all the grain that we should require for food, but also all the foodstuffs, partly as by-product from the grain and partly grown, that would be required for raising the cattle, sheep, and other animals necessary to supply the whole of our wants.

It is now beginning to be understood that intensive farming of the land also involves intensive cattle raising, and that it is very advantageous greatly to reduce the amount of grass land and instead to grow crops intensively cultivated, as in this way a given amount of land can be made to produce a much larger yield. Sulphate of ammonia is a particularly good fertiliser for the purpose of growing sugar beet, and here again it is probable that the availability of large quantities of this fertiliser at a very much lower price than at present prevails would enable us to produce the whole of our sugar at home, especially as the by-product obtained in the form of crushings from the beet is a very valuable food for cattle raising, and also as the crop is a very suitable one for growing alternately with wheat.

It was found that a larger amount of fertiliser than the 3 million tons of sulphate of ammonia, which would be the principal by-product from the 60 million tons of coal turned into electricity, could be advantageously used, this would be very economically produced from the electrical station by the oxidation of atmospheric nitrogen, giving a valuable fertiliser in the form of nitrate of lime. This could be made intermittently by means of current filling up the load curve and would not necessitate the expenditure of any more money on plant for generation or transmission of the current. It would, however, require the burning of additional coal, and this in itself would add to the sulphate of ammonia available. The output of the 25 million kw. of plant installed has been reckoned upon a 60% load factor, but it is quite possible that the load curve could be still further filled up by an additional 20% for any purposes such as those just stated. In this way it would be possible to burn an additional 20 million tons of coal annually, producing a million tons of sulphate of ammonia and other by-products, and 43,800 million additional units, which could be sold at a considerable profit at $\frac{1}{20}$d. per unit, as the cost would not exceed $\frac{1}{50}$d. per unit.

A certain proportion of this extra supply of current could be used to fix nitrogen in addition to that obtained direct from the coal, should this latter supply be insufficient

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for the country's wants, and the balance of the current used for electro-chemical or other requirements which could take power intermittently. In this connection it must be remembered that an intermittent or controlled make-up load may be intermittent to the extent of 80 or 90% of the load, a certain amount of current being always kept on to make up for heat losses in furnaces or to prevent reversal in electro-chemical work.

If the whole of the additional output could be taken up the effect of the increase of revenue, together with the difference on the original figures of selling the first 60% at an average of $\frac{7}{8}$d. instead of at the lower figure of 0·1145 of a penny already mentioned, would enable $10\frac{3}{4}$% to be allowed on the capital instead of $8\frac{1}{2}$% already provided for.

It is assumed by many people that the climate of this country is largely unsuitable for the purpose of growing food, and for this reason it is thought that we can never grow the food which we require. This is largely a misconception, as crops both large in quantity and of good quality can be produced in this country. Nevertheless, it would be a desirable thing if, instead of the dark weather that we now often experience owing to cloud obstruction, we could have continuous sunshine at certain times of the year. The amount of sunshine would, no doubt, be largely increased by the abolition of all smoke in the air, as not only does the smoke itself obscure the sun but also it seems to have the effect of assisting the formation of cloud, which greatly diminishes the light and heat which we receive.

At present it is considered quite right and reasonable to canalise rivers and make great works for adding to the fertility of countries by means of irrigation, but I believe that in the future the time will come when it will be thought no more wonderful largely to control our weather than it is now thought wonderful to control the water after it has fallen on the land. I think that it will be possible to acquire knowledge which will enable us largely to control by electrical means the sunshine which reaches us, and, in a climate which usually has ample moisture in the atmosphere, to produce rainfall when and where we require it. It seems to me that it may be possible, when we know a great deal more about electricity than we do to-day, to set up an electrical defence along our coasts by which we could cause the moisture in the clouds to fall in the form of rain, and so prevent these clouds drifting over the country between ourselves and the sun which they now blot out. It also seems to me that it will be possible, when more water on the country is required, to cause the falling of rain from the clouds passing over the highest part of the country and so produce an abundance of water which, properly used, would greatly add to the fertility of the country. Of course, it may seem that these are only mad visions of the future, but I think we can hardly consider these results more improbable than any one would have considered wireless telegraphy or flight in heavier than air machines fifty years ago. My excuse for mentioning these matters here is that they might constitute another great use of electricity, and their useful consummation would certainly be facilitated by an abundant supply of electrical energy.

There would be further by-products from the coal in the form of tar and light oils. The effect of their abundant production and sale at a low price would be most important to the country, as the large quantity of tar produced would enable us to make good roads, which we much need, and which would have the lowest cost of upkeep, and the light oils would, when carburettors have been further developed, go a long way towards supplying the fuel for our motor-cars and other motor vehicles which we now have to import from abroad. As there must be an enormous development in the way of motor traction these two by-products become most important. The necessity for labour-saving appliances used in agriculture must greatly add to the number of motors which cannot, according to present knowledge, be replaced by electricity, and these, no doubt, would be made to burn the heavier oils which would be produced as part of the coal by-products.

Considering the general effect of the all-electric scheme, in which, with but small exception, the whole of the coal used is turned into electricity, the first important effect would be the saving of some 80 to 90 million tons of coal a year. As we should produce the whole of our food requirements, we should not have to export our capital in the form of coal to help pay our food bill. In this way, by making these two savings, we could prolong the useful life of our coal measures two and a half times, and still have 20 million tons of coal a year available for the use of our steamships over and above the coal required in the country.

The saving of labour now employed in raising the vast amount of coal which we now waste or send abroad, and also the labour employed in transporting this coal and using it for all the various purposes for which it is now required, together with the labour employed in cleaning up and getting rid of the effects of burning coal according to our present methods, would all be available for additional manufacturing of the articles now imported and for use on the land. The saving of so much wasted labour and material would greatly add to the prosperity of the country and so enable us to support a larger population living under more healthy and comfortable conditions than at present.

Cheap electricity would greatly stimulate all manufacturing operations, which would, in turn, enable labour to be much better remunerated than at present, and to enjoy a much higher standard of comfort. The higher value of labour would in its turn stimulate inventiveness and the production of all sorts of labour-saving appliances which, with cheap electricity, would enable us to produce in the future under suitable market conditions at cheaper rates than are now possible, notwithstanding the better return that labour would obtain.

Great hardships are always produced where any great industrial change is made, but the more efficiently we carry on the work of the country the more margin must there be for the great majority of the people: so that any change which decreases the amount of labour required must eventually give the people greater comfort and less arduous work. It is hardly necessary to point out how much better the position of the country would be if we were producing the whole, or nearly the whole, of our requirements, as in this case we should be far less liable to be adversely affected by any external causes or by the occurrence of any great war.

At present, although the using of our coal may mean commercial activity it certainly means the desolation of the country in parts where it is largely used. Instead of this harm being done to the country by our coal, we should fertilise the lands by its means and might even, as I have indicated, use it in the future to increase our sunshine.

Of course, there are many things which at present stand in the way of realising such a scheme as I have outlined. There are many technical details which nothing but an immense amount of work can solve satisfactorily. The more, however, that I have considered these ideas in detail, the more certain am I of the fundamental soundness underlying them and that it is only a matter of time before such a scheme is carried out in its entirety.

What interests us most, perhaps, is the question of how long it is likely to be before the all-electric idea becomes possible. At present there is so much required to be done to make it workable in all its details that it seems as though its realisation would be long deferred. It must, however, be remembered that knowledge is continually being acquired which brings us nearer to its realisation, and that things engineering, and especially in electrical engineering, now move very rapidly. It may therefore come to pass that the all-electric idea, with its far-reaching changes and great benefits, will become an accomplished fact in the near future.

A vote of thanks to the president for his address was proposed by Mr. R. K. Gray, seconded by Dr. Glazebrook, and carried unanimously, and the proceedings then terminated.

The second meeting of the Session will take place on November 24, when a paper entitled "Street Lighting by Modern Electric Lamps" will be read by Mr. H. T. Harrison.

COMPANIES REGISTERED.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

The dark cloud which has been resting over Tyneside industrial affairs is beginning to show just a fringe of its silver lining. In the first place the executive council of the Boilermakers' Society this last week communicated with the Shipbuilding Employers' Federation requesting the latter to take down the lock-out notices pending the renewal of settlement negotiations. If the employers would hold out the olive branch to this extent there might be a hope of satisfactory settlement. Even better than this is that the emergency committee of the Employers' Federation has met the President of the Board of Trade, and that strong hopes are entertained that the President may find a way out of this deadlocked lock-out, which is crippling industry to such a serious extent. If, as the politicians assert, a General Election is to take place very shortly, it is advisable that no effort should be spared to get the strike over. Engineers going to the poll on an empty stomach may very likely vote peculiarly.

Civic Developments.

The city of Newcastle-on-Tyne seems to be having as much trouble in fitting itself with a new Town Hall as the average lady has in choosing a hat. A special meeting has been held by the New Town Hall and Estate and Property Committee to discuss the proposal of erecting the new hall on the site of the present Northumberland Baths, and the removal of the Baths to another site. An alternative proposal was to reconstruct the Baths on their present site at a cost of £20,000. After a long and animated discussion it was decided—to postpone the matter for a fortnight!

Other public buildings are, however, in progress in Newcastle. Two of these are devoted to military purposes. One is the reconstruction and alteration of the First Northumbrian Field Artillery, Territorials, headquarters in Barrack-road. The alterations include a riding school, a gun park and a new drill hall, together with stables for the horses. The other is the building of the headquarters in the Sandyford district of the Army Medical Corps, Field Ambulance, and the Northern Cyclists Battalion. The buildings will contain a Morris tube range, drill sheds, mess rooms, etc. Electrical engineers will do well to keep the lighting out of the hands of opposing interests.

Tramway Work.

The extensions to Newburn are still occupying attention. The estimated cost to Newburn will be about £6,267, and the total cost of the improvements will be about £11,800. The Newburn Council have agreed to pay their part, so that there seems to be now no obstacle to the extension. Another item of news is perhaps more dramatic, but has a useful bearing on tramcar design. An opinion has been expressed more than once as to the doubtful stability of the double-deck car. This was put to the test last week by a crowded car of this type running off the track, crashing through some railings and coming to rest in a plantation on the edge of the moor. In spite of all this the car retained its upright position, which was fortunate in view of its crowded condition, and the experience is satisfactory as showing the value of a lowly placed centre of gravity.

Whitley Bay and Blyth.

A dispute which has been waged between the Council of Blyth and the Harbour Commissioners as to the construction of a railway crossing over a highway has now been settled. It is as well that this is so, as it appears as if the particular development is an integral part of the scheme of harbour development on which the industrial development of Blyth so largely depends. At Whitley Bay a scheme is on foot to improve the sea front, which may ultimately develop into a second promenade at a lower level than the present one. There will evidently be an opportunity for a comprehensive and adequate scheme of arc lighting.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

Considerable interest is being shown in the Midlands in the experiments which are now being made with reference to the stimulating of plant growth by electricity. The subject was dealt with on Monday evening at the Birmingham and Midland Institute by Sir Oliver Lodge, Principal of the Birmingham University, who, with the help of his laboratory assistant, Mr. Robinson, and his son, has taken a considerable part in the local investigations. Sir Oliver pointed out that the discoveries of Pasteur with regard to the action of micro-organisms, though originally they appeared to be only of medical interest, had had an influence upon agricultural practice and the theory of manuring. A multitude of facts had come to the front which explained old practices and suggested new ones, so that a farm had become a laboratory of great importance and life in the country, far from being dull, was full of absorbing interest, the interest extending over all periods of the year. Having pointed to problems which were receiving or were yet awaiting attention, such as the action of nitrifying bacteria in the soil, the influence and function of leguminous plants in the rotation of crops, the whole process of the absorption and assimilation of sap, the chemical changes going on in the laboratories of the leaf under the influence of sunshine, and the discharge of electricity from plant surfaces under the action of light, Sir Oliver emphasised the importance from the point of view of national safety and national wealth of everything affecting the fertility of the soil. Having indicated a number of other lines of investigation, Sir Oliver said that now there had come the problem of the electrification of the air above the growing plant.

Natural and Artificial Electrification.

Such electrification, he said, always exists, and the pointed character of the leaves, which makes them natural lightning conductors, shows that it is made use of. But by artificial means it can be intensified, the plants stimulated, and the action of feeble sunshine accelerated and assisted by high tension electricity purposely conveyed through the atmosphere above the plants. Work in this direction has been done in Sweden and by the French scientist Berthelot long ago, but the means available for electrification were but imperfect and feeble. Only recently had we been able to supply electricity of the kind desired in a fairly easy and permanent and engineering manner, so that when Mr. Newman and Mr. Bomford wished to try experiments of this kind on a large scale in the neighbourhood of Evesham, he (Sir Oliver) was able to assist them with a proper apparatus and the mode of producing electricity. Dr. Priestley, of Bristol, a scientific chemist and botanist, had also given careful attention to the testing of results, and his views on the subject were very rosy. An Agricultural Electrical Discharge Company had been founded by Mr. Newman at Gloucester, and was sending apparatus to many parts of the world—to Germany and Austria, to Java and Sweden, as well as to Scotland, for experiments by Mr. Lowe, at Balmakewan, who is testing the whole process scientifically and financially for a period of five years.

Mechanical Devices.

The success of the experiments depended, Sir Oliver explained, on an electric valve which he had designed and which allowed the electricity to go in one direction, and one direction only. He illustrated this by means of a Leyden jar, which without the valve discharged itself in the usual way, but with the valve simply overflowed, or gave out a continuous spark. In practice a number of the valves were placed in series, and the current was carried by insulated wires, which discharged positive electricity high above the plants, thus imitating the action of the ultra-violet rays in bright sunshine. It was known that after a thunderstorm plants grew more rapidly than could be accounted for by

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the rain, while in Polar regions the vigour of the vegetation, in the absence of strong sunshine, might be attributed to the high electrification of the atmosphere.

It was five years ago that experiments, at the suggestion of Mr. Newman, of Bitton, Gloucestershire, were commenced in a wheatfield of 20 acres at Berrington, near Evesham, with the co-operation of the owner, Mr. Bomford. A control field of 20 acres was cultivated under similar conditions, except as to electrification, and the yield of the electrified field, when thrashed out, showed for the first year an increase of 36%, though some other years had not been quite so good. Sugar beet showed an increase in sugar and strawberries came earlier and sweeter. Generally, the tops of plants benefited most, and this was the case with potatoes, which had larger tops but smaller though more numerous tubers. The treatment did not suit leguminous plants, but it might be worth while to try them with the other electricity. The expense was small, a 2 h.p. engine sufficing for 20 acres. On a larger scale, of course, the cost would be reduced, especially, as in the case of a farm at Buda-Pest, where electricity was used for all farm purposes. Sir Oliver added that the apparatus might be used for many other purposes, including the elimination of fog from harbour stations—there ought to be no fog in towns, if we burned our coal properly—and the control to some extent of the weather.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The Glasgow Athenæum is an educational institution which has survived under a private board of directors, when other similar concerns have been absorbed or superseded by up-to-date schools under governmental control. Until recently the Athenæum got its electric lighting and power supply from its own generating plant. During the past year, however, this plant has been scrapped and the whole supply taken from the Corporation mains. At the annual meeting of the shareholders the other day the chairman reported that it was gratifying to be able to record a balance on the right side. He said they were indebted for that result to the saving effected through the substitution of the Corporation electricity supply for their own plant. For the lighting supply the Athenæum are paying the usual Corporation rates of 3½d. for the first 730 hours use of the maximum demand and ¾d. per unit thereafter. They are now considering the question of putting in electrically-driven fans in place of the present steam-driven ones. The plant scrapped consisted of water tube boilers, four Willans engines driving Holmes dynamos with a total capacity of 200 kw. The consumption is about 50,000 units per annum. This is another striking proof of the economies which are possible in a large central source of supply as against the small privately owned plant. The plant just dispensed with has been running for some 18 years, and the installation was one of the earliest large electrical equipments in Scotland.

New Generating Station in Glasgow.

In connection with the new generating station to be erected in the East End of Glasgow by the Corporation Electricity Department, the Board of Trade have now given their formal consent that this station may be built on the site purchased for the purpose. It is interesting to note that the ground on which this station is to be built has been bought at the figure of 8s. per sq. yd., whereas the Port Dundas site cost 25s., the St. Andrew's Cross site 36s., and the Waterloo-street site in the centre of the city £10 per sq. yd. The fact that the necessary preliminaries with regard to the new station are so far forward is no certain indication that plans and specifications are in a similarly advanced state; it is not expected that anything definite in the latter connection will be done until the autumn of 1911.

Heating and Cooking.

Business in heating and cooking appliances is being rapidly developed in Glasgow. The possibilities of the apparatus on the market continue to be tested in various quarters, as was done at the Smoke Abatement Exhibition. The results of these experiments so far are said to be distinctly encouraging, and when properly tabulated and published should tend to encourage and accelerate this branch of the business.

Tramway Extensions.

Dunoon Town Council have agreed to the proposal by a private company to lay down a tramway for Dunoon and Sandbank. The company is prepared either to provide the power or to take it from the Council. This means the erection of works and an application for a Provisional Order. It looks as if the private company were to be allowed a fairly free hand both as regards the provision of power and the getting of the necessary order. The only stipulations the local town council make are that the company shall bear all the initial expense, that there shall be no overhead trolleys and that their main street be laid with whinstone sets and the other parts of the route with tar macadam. There is also the further characteristic condition that the cars shall not be run on Sundays. Trial runs have been made on the recently constructed branch of the West Fife tramways extending from Cowdenbeath to Kelty, a distance of about 3 miles. It is expected that the Board of Trade inspection of the line will take place at once, after which the conveyance of passengers will be begun.

Cheap Power.

In a paper read on paper-making machinery at the Scientific Society of the Glasgow Technical College a day or two ago it was stated that at the Linwood paper mills, belonging to Messrs. Watson & Company, electricity, on a 24 hours a day load, was being generated for power purposes at a cost of ·186d.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

A new meter has made its appearance on the Berlin market which is suitable for dealing with weak alternating currents of high frequency. It permits of the determination of the relative strength and phase of different alternating current tensions in one or more circuits on the compensation principle. It is the invention of Professor Larsen, of Copenhagen, and is especially useful in connection with telephony, but it also renders great service in the estimation of induction constants and effective resistances.

Wireless Detectors.

Dr. Max Reich, of Gottingen, has patented a method of testing wave detectors. Its principle is to produce a weak continuous current by the induction of the high frequency currents in the receiving wires. The detectors are put in circuit between the poles of a small high frequency machine of from 4,000 to 6,000 periods, and the induced continuous current is measured with a direct reading galvanometer.

German Wireless.

Germany's highest summit, the Zugspitze (9,700 ft.), has now been made into a wireless telegraphy station. The station on the top of the peak communicates with the station at Norddeich, and supplies Greenwich mean time to vessels navigating the Mediterranean.

Platinum.

The refining of platinum is a great industry in Hamburg, and just now there is great alarm in that city and strong protest against the intention of Russia to forbid the export of crude platinum. When it is considered that about seven-eights of the world's production of platinum is produced from the Ural mountains the importance of the matter to German industry is easily understood. The Russian Government has decided to establish state refineries, and as Russia has very little use for platinum the exports will mean practically the whole output of the metal. When the world's supply of platinum is refined as well as produced under Russian supervision it will be easy to place the causes of exorbitant prices, even if the private speculators have to give way to Grand Dukes, as has happened with petroleum.

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Company Affairs.

The Elektrische Licht und Kraft Anlagen A.G., Berlin, has increased its net profits from 1,704,260 to 2,078,068 marks. As, however, the carry-over has been put at 506,932 instead of 169,250 marks, the dividend remains at 7 per cent. The company has made ample provision for future contingencies.

The Elektrizitatswerk of Strasburg is flourishing apace after a period of depression. The dividend for 1909 is 11 per cent. on the old shares as for 1908, although the profit rose from 990,107 to 1,155,095 marks. The increase of capital that had been made necessary, viz., from 7½ million to 11¾ million marks, is thus fully justified. Even had the dividend been a little less the fact would have been no cause of anxiety, considering the great increase in the number of shares, and that the new shares realise 5½ per cent. as it is.

The net profit on the Stettin trams fell from 356,914 marks in 1908 to 351,950 marks in 1909, but the same dividend, 7½ per cent., was paid on the capital of four million marks. 17,682,671 passengers were carried as against 17,052,194 in 1908. The former figure corresponds to 5·35 persons per car mile. The takings rose slightly to 6d. per car mile.

The Vereinigte Elektrizitats A.G. of Vienna has delcared a 6 per cent. dividend for 1909-10, the same as for last year. The company is still engaged in making arrangements with the Brown Boveri Werke. The net profit was 544,193 k.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

In one of those "twenty-minutes-talks" after lunch which have become so popular a feature of the Chicago Electric Club, Dr. Charles Proteus Steinmetz, the well-known consulting engineer of the General Electric Company, and Professor of Electrical Engineering at Union University, sometimes known as the Lord Kelvin of the United States, took for his subject last week the various phases of electricity. He began by saying that if he were asked the question, "What is electricity?" he would answer after his questioner told him what gravity is. Dealing with various forms of energy, he said that chemical energy could be converted easily into heat, while electrical energy had the great advantage that it might be converted easily into other forms of energy as well, while electrical appliances designed for the operation of mechanisms may be and are planned so that they may be used by persons not at all familiar with electricity. Thus the motorman of a trolley car need not be an expert electrician, but the driver of a steam locomotive must have an intelligent understanding of the mechanism under his charge. But, he said, when the time element in relation to the utilisation of energy is considered electricity is placed at a serious disadvantage. Electricity cannot be stored. In the storage battery it is really chemical energy and not electricity that is stored. Electrical energy must be used when produced and produced as needed. Thus, if the customers of a central station were to use all their requirements in two hours it would cost almost as much to serve them for that two hours as it would to operate the station for 24 hours. Therefore, the cost of electricity depends on the degree of uniformity with which it is used; in other words, it depends on the so-called load factor, which is the ratio of average use to maximum use. It follows that electrical energy has not a fixed cost; the cost is a function of the rate of use; it will be high where the load factor is low and low where there is a uniform use—say of 24 hours a day, as in the case of some electro-chemical industries. Lighting alone results in a low load factor; factory or industrial requirements give a higher load factor. By combining these two demands a still higher load factor may be obtained, resulting in lowering the cost proportionally by utilising the total investment to a greater extent. It is apparent from these considerations that there is no real fixed limit in the cost of electrical energy either upward or downward. Large generating stations are undoubtedly more economical than smaller ones, but there is a limit to the economy which may be secured in this manner. It is to be observed, however, that by increasing the load, which makes necessary a larger station, the load factor becomes higher, and it is this fact that enables the price of electricity to be lowered, rather than the economies obtained by the use of the large generating units.

The Electrostatic Field.

During the same week Dr. Steinmetz was the principal speaker at a joint meeting in Chicago of the Western Society of Engineers and the Chicago Section of the A.I.E.E. and dealt with electrostatics and electric impulse forces in relation to the present day 20,000 volt underground cables and 110,000 overhead transmission lines, conditions which render this oldest form of electrical science of supreme importance. Discussing the present-day application of Faraday's conception of lines of force, Dr. Steinmetz observed that the early ideas of magnetic charge, magnetic quantity, etc., have disappeared, and given place to such terms as magnetic flux reluctance, permeability, etc., that are physically conceivable; and he went on to say that in considering what goes on in an electric circuit, it is evident that there is a consumption of power in the wires of the circuit, but there is also action set up outside the wires, as is shown by a magnetic needle disclosing the presence of a circular magnetic field about the conductor. Moreover, he said, light, movable bodies will place themselves in a radial direction, showing the presence of an electrostatic field. Whereas the magnetic lines of force are concentric circles about the conductor, the electrostatic lines of force are radii diverging in all directions. The strengths of the magnetic and electrostatic fields have no relation to the power in the circuit. Dr. Steinmetz then showed in detail the similarity of the mathematical expressions for the magnetic and electrostatic fields. This is made more clear by the lines-of-force conception. The flux in the magnetic field is proportional to the inductance and to the current; the flux in the electrostatic field is proportioned to the capacity and potential. Both these fields represent stored energy due to power supplied in establishing them. Akin to the permeability as related to magnetic flux is the specific capacity in electrostatic flux; the former is unity for air and most materials, except magnetic bodies whose permeability is very high; the specific capacity is unity for air and gases, but solid dielectrics have higher values ranging up to about 10. Corresponding to magnetic ampere turns per unit length are dielectric volts per unit length or voltage gradient. The magnetic flux density can be increased up to a limiting saturation point. The dielectric flux density can be increased up to a limiting value which is the breakdown point or voltage gradient at which the dielectric becomes a conductor. In air this critical point is about 35,000 volts per centimeter. At the critical point air and gasses become luminous. Corona is merely air past the electrostatic saturation point. The calculation of corona problems is made theoretically very simple by the conception of electrostatic lines of force. Naturally the constants must be known and these static constants are not yet reliably known. Secondary phenomena influence the distribution and complicate the problem. With the smallest size of conductors for long-distance transmission, about ¼ in. diameter, corona begins at about 75,000 to 80,000 volts. Therefore, until the advent of commercial 110,000 volt lines, little trouble was experienced from this cause. At each change of the circuit, transcient phenomena are set up which are greatest at the opening of the circuit. The magnetic energy stored up is then converted into electrostatic energy and results in oscillations or a standing wave. The stored electrostatic energy, on the other hand, is converted into magnetic energy and produces a travelling wave. In high voltage transformers, with high inductance and low capacity, opening the circuit sets up a very high voltage and low current; in underground cables, with low inductance and high capacity, there is set up a low voltage and high current. Where a travelling wave passes from one type of circuit to another there is a transformation from current to voltage. In a cable this surging current does no particular harm because it is at a low voltage, but at transformer terminals the voltage is extremely high and may cause a breakdown of the insulation. In fact, at the entrance to all inductances these electric impulses produce a building up of voltage, which, though of low power, may be several times the normal circuit voltage. In high tension underground cables there are always present high frequency waves as on

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the ocean. The same is true of long-distance overhead lines, but in these the resistance is relatively high and therefore the damping effect on these waves is much greater.

Electricity and the Corpuscular Theory.

In his lecture before the American Electrochemical Society (of which the portion dealing with the isolation of an ion was transmitted to the ELECTRICAL ENGINEER last week), Professor Millikan, of the Chicago University, dealt with the laws of the electrodeposition of metals in relation to the ionic theory. It was found, he pointed out, that in the transfer of energy through the electrolyte, definite weights of the element transported are always associated with definite quantities of electricity passing through the cell, and that these electrochemical equivalents bear, in their turn, a significant relation to the atomic weight and valence of the element involved, thus demonstrating that electrical charges imparted to a body are always in multiple proportion of the ionic charge. Professor Millikan observed that corroborative data were added to this hypothesis by a study of the phenomena of the Crookes tube, the cathode rays of which, at first thought to be a kind of light wave, were later shown to be actual bombardments of charged particles or corpuscles given off by the cathode plate and moving at such high velocities as actually to give rise to magnetic effects. When it was discovered that these cathode rays might be deflected by traversing a magnetic field, the theory that they were merely a new kind of ether vibration had to be given up, especially as it was shown later that except for proceeding in straight-line paths they were in no sense like light. Precisely similar cathode rays were given off from all kinds of cathodes regardless of their composition, and later it was shown that these same rays could be set up under the action of heat and ultra-violet radiations as well as at the cathode of a vacuum tube. By determining the deflection produced by this corpuscular bombardment traversing a magnetic field it became possible to place the value of the mass of the constituent ions at about 0·0005, that of the hydrogen atom. The ionic charge manifested under conditions of ionisation in gases compares exactly with that noted for electrolytes.

A Natural Unit of Measurement.

Commenting editorially on Professor Millikan's isolation of an ion [ELECTRICAL ENGINEER, page 513] the "Electrical Review and Western Electrician" of Chicago observes that the existence of an elementary charge or electrical atom suggests at onec that such a natural unit should be used as a unit of measurement, or at least that the unit of measurement for electrical quantity should be based upon it. "The suggestion has indeed been made," says the writer, "that our entire system of units be based upon such constants of nature, such as the velocity of light in space, and it is of course possible to construct such a system. While such a system may appeal to sentiment, it has little to recommend it from a practical standpoint. Its principal advantage is that the unit is independently reproducible, and does not depend upon the preservation of any particular piece of pieces of matter, such as are now preserved by our own and other governments to perpetuate the kilogram, foot, etc. The units not only would be independent of any particular body, but would not even depend upon the properties of any particular substance. An objection to such fundamental units is that they are not conveniently available for direct use. Another is, that most of them are not known with the accuracy which is possible with our present units. As to reproducibility, when the relation between one of these constants of nature and our present units is once determined, the unit can then be reproduced regardless of its particular value." In this connection it has to be noted that among others Professor A. Michelson has determined the relation between the meter and the wave-length of a particular line in the spectrum of cadmium, and the meter can consequently be reproduced at any time from the knowledge of this relation independently of any other standard of length, and necessarily a similar consideration applies to the unit of electrical quantity.

The Ideal Artificial Luminant.

In his presidential address at the Baltimore Convention of the Illuminating Engineering Society in the Johns Hopkins University, Dr. E. P. Hyde laid down the standard of the ideal artificial illuminating medium. He described it as such a luminant as, apart from questions of form or magnitude, polar diagram or intrinsic brilliancy, would transform all the energy supplied to it into luminous radiation of the colour of sunlight. This ideal could be attained if all the energy supplied to a lamp was converted into radiation, and radiated throughout the visible spectrum instead of within the wave-lengths of a single colour. Such a distribution of energy, if it were attainable, would produce a light which would exactly match daylight in quality and would correspond to an output of 300 lumens per watt, or nearly six times that of the most efficient artificial luminant of the present day. Whether illuminating engineers will ever be able even to approximate to this standard is a matter which rests on the knees of the gods. At the moment no substance is known to scientists which indicates even the possibility of such extreme selectivity. Dr. Hyde believes that if an output of several hundred lumens per watt is ever to be attained, is must be sought in the radiation of so-called luminescence as exemplified in the flaming arc, but even then he regards it as improbable that the bright line spectrum would consist of so many lines of such relative intensities that the integral quality would be that of sunlight and give true colour renderings. Moreover, says Dr. Hyde, "life upon this earth, as we know it, is dependent on the warming influence of the solar radiation, much of which is beyond the limits of the visible spectrum, and yet one of the conditions of the ideal source precludes any radiation except in the visible spectrum. Many destructive and constructive organic chemical processes are attributed to the ultra-violet radiation in daylight, and yet one of the conditions of the ideal artificial source implies the exclusion of ultra-violet radiation. The demands we have made upon the ideal artificial source render it unnatural and no one knows the bane or blessing involved in those very radiations which one should studiously avoid." Nevertheless, it would seem clear that, although the most efficient source possible as the result of the evolution of scientific research may not yet have been developed, we have not yet utilised to the limit of their possibilities all the sources known to be available; and, indeed, it has frankly to be admitted that the art of the illuminating engineer is not yet abreast of the material illuminants with which it deals; and Dr. Hyde himself claims that the goal of illumination will not have been attained until, "as a result of the concomitant development of its component illuminants it will be possible in every case presented to design a lighting installation which will be efficient, effective, artistic, which will produce an illumination correct in quantity and quality, properly balanced as to high lights and shadows, restful to the eye and harmonious with the form and numerous colour schemes involved, which will stand the rigorous test of logical analysis and will appeal to the most highly developed sense of beauty."

Sixteen Years of Litigation.

The famous electrolysis lawsuit, in which for 16 years the Peoria Electric Railway has been the central figure, has at last come to an end, and the full text of the judgment promises to be of standing importance far outside the limits of the United States. This full text is not yet available, but its essence is discernible in the preliminary decision which was made public this week by Judge A. L. Sanborn, of the United District Court of Madison, Wisconsin. This preliminary decision is the work of a Special Master, to whom Judge Sanborn referred the case in 1907, and the circumstance that the Master has taken three years to arrive at a final conclusion will give the electrician some idea of the vast mass of expert testimony which had to be examined and pronounced upon. Basing his decision upon this report, Judge Sanborn now pronounces that the injury to water pipes from electric railway currents, which was the original ground of action, not only very palpably and demonstrably exists, but is permanent and continuous, and is solely chargeable to the electric railway company, and cannot be remedied by the water company. The Judge further declares that the damage can and must be prevented by the railway company, and that the method of prevention must be by "the use of double overhead trolley or by any system which provides a completely insulated metallic circuit for the electric current." But whereas the Special

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Master (who is of necessity a high authority on electrical matters) expressly declares that to avert further damage the railway company should be compelled immediately to instal a double overhead trolley system, the Judge (who is not necessarily an electrical engineering expert) comes to the conclusion that the installation of the double trolley " is unreasonably expensive, and its use dangerous, and it would not entirely prevent the escape of the electric current to the ground." In the end, therefore, the Judge merely decrees that the railway company shall be given a reasonable time in which to put in such improvements to its negative return " as will substantially prevent injury." What the Special Master thinks of this perversion of the results of his three years' study of the case is not on record.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the apparance of the questions.

ANSWERS.

Question No. 1231.—Will some reader state the chief items of meter maintenance and their relative importance and cost ? Also, which errors are most likely to occur, in the calibration, during use ? What is their magnitude, how may they be detected and how avoided ? How may a meter best be kept in good condition over long periods ?

Answer to Question No. 1231 (*awarded* 10s.).—Such errors as those of coulomb-meters used as energy-meters on circuits of variable voltage are not considered below, these being due to errors of principle (in the example cited, to the erroneous assumption of *constant* pressure), whereas only errors in the meter itself are here dealt with. The importance of accuracy in supply meters cannot be exaggerated since the gross revenue of a station depends directly thereon. Inaccuracies or inefficiencies in other parts of the system have a far more local influence and importance : thus, an inefficient steam engine merely affects the coal bill.

Unfortunately the desirable accuracy (or, at least, premanence) of calibration is difficult to secure, and few meters in service have a less error than 3 per cent. or 4 per cent., at loads between ¼ and full load, however careful their initial calibration. Of more than 1,000 supply meters, tested in Munich several years ago (over a load range of 10 per cent-120 per cent. full load), only 40 per cent. had an error of less than 4 per cent., while a further 40 per cent. had errors varying between 4½ per cent. and 10 per cent. The meters tested were of the motor type and swinging element type. Errors of = 3 per cent.-5 per cent. at the highest and lowest loads of a meter, respectively, are legally permissible, but it is clearly essential to know the exact values.

Meters are invariably calibrated before being placed on the market, but it is futile to rely upon such calibrations unchecked. Indeed, so susceptible are most meters to the rough handling of transit that it is well, whenver possible, to test their calibration after they have been installed in their working situation.

In order to keep the meter in a satisfactory condition and to safeguard against loss of revenue or injustice to the consumer it is necessary to organise a system of regular and fairly frequent (from three months to one year) inspection and testing. Portable testing meters are sufficiently accurate to indicate whether anything is radically wrong with the calibration of a meter and, in most cases, to enable the correction of the meter constant. When the error is great or vacillatory the meter should be removed to the station testing laboratory and thoroughly overhauled. This process should include a thorough cleaning, examination for mechanical defects, test of insulation resistance and of the starting current, and accuracy of calibration (at at least three loads and, in the case of alternating current meters, at two or three power factors (*e.g.*, 0·5, 0·75 and 1·0 for each load).

The standard test meter must be reliable, easy to use and of variable range. Unless a perfectly constant supply voltage is available it is advisable to use a rotary test meter rather than one with a swinging needle (since oscillations of the latter are troublesome). By providing a variable range test instrument the standard can always be worked at near its full capacity : it is thus free from those errors which influence the tested meter at low loads and which it is desired to accurately determine.

In the case of meters having both series and shunt coils, the series circuit should be fed from an independent *low voltage* source, the shunt coils being meanwhile fully excited from a high voltage supply : the energy used during a test is thus reduced to a minimum. By arranging that the " constant " of the standard meter is decimal (1, 10 or 100, etc.), and by taking a decimal number of revolutions (preferably of the armature spindle, since this is the fastest moving part) of the meter under test, the necessary calculations become very simple. Such points, apparently trivial, facilitate the rapid conduct of accurate yet cheap tests on large numbers of meters (see also reply to Question No. 1182, June 11, 1909).

Apart from serious mechanical or electrical damage, meters begin, after a period varying from six months to several years, to run too fast or too slow—usually the latter. Fast running is usually traceable either to failure of the series windings (coil to coil or coil to frame) or to weakened " damping " magnets—caused by " ageing " of the steel or partial demagnetisation of same by stray fields. Slow running is attributable to charring of the shunt coils, or more usually to increased mechanical friction. The frictional resistance increases if the bearings of the main spindle wear, if dust or insects get inside the meter casing or if the armature spindle be slightly bent.

Mechanical damage is usually obvious after a very cursory inspection while electrical damage may be detected by a lack of continuity of the circuits or by testing the insulation resistance with a " Megger."

Having taken out and examined the main spindle and thoroughly cleaned all the moving parts of the meter, roughness of the bearing jewel may be detected by a needle point or by inspection through a lens. If necessary, new damping magnets must be fitted.

It is obviously desirable that the overhauling, once completed, shall not again be necessary for some time ; indeed, it should be remembered, throughout the design, manufacture and use of supply motors, that *permanence* of calibration is *preferable* to *absolute accuracy* of calibration, if both cannot be simultaneously secured. In order that insulation breakdowns may be a minimum, mica plates should be used below all coil and wire clips. As bearing jewels, sapphires have largely given way to diamonds, which, though more costly, are much more durable and efficient : spring mounted jewels are commonly employed and possess obvious advantages. To avoid demagnetisation of the " damping " magnets, as far as possible these should be placed *across* the stray field of the meter and *not along* it, as was formerly often the case (see also reply to Question No. 1196, August 27, 1909). To reduce the number of bent spindles, the latter should not be made too thin in the endeavour to secure lightness. All gearing parts must, of course, be of non-rusting metal and the meter-case must be dust and air-tight.

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A constant current "friction" coil is usually placed near the armature of modern motor meters: this coil exerts a positive acceleration on the armature nearly equal to the negative acceleration of the frictional resistance. Where a commutator is employed it is useless to calibrate the meter or adjust its friction compensator till the invariable rise in brush friction (taking place after a few hours' run) has occurred. The brush friction of a commutator-motor meter seldom falls below five or six times the bearing friction.

It will be seen that most of the above means of securing a *permanent* calibration can be applied to old meters as occasion arises.

It is never safe to take the "starting" current of a meter as an index of the correctness or error of the calibration of the instrument at higher loads. There is no objection to the starting current rising as the meter ages, providing that it is always less than the consumer's minimum demand. It is seldom necessary to reject a meter solely on account of its high starting current. Electrolytic and "clock" meters are more accurate, on light loads, than motor and intermittent meters: the compensating disadvantages of the old Aron meter have been largely removed by the application of electrical operation to the clocks themselves.

The temperature errors of a meter do not, as a rule, vary greatly during the life of the instrument, but, unless they are compensated for by the use of coils of negative temperature coefficient wire they may be very serious. Such errors are tested for in the ordinary way, and, in an uncompensated meter, may amount to $\frac{1}{4}$ per cent, or $\frac{1}{2}$ per cent. per 1° C. Compensation for temperature changes is essential in electrolytic meters (note, however, that there are no starting and frictional troubles with these instruments).

Alternating current meters, besides being subject to the usual troubles of d.c. types (with the exception of commutator difficulties), have their own special errors, the chief of which are the dependence of the calibration on :—

1. Frequency and wave form of supply current.
2. Power factor of circuit metered.

To detect and allow for these special tests must be arranged: direct current calibration is, alone, insufficient for an a.c. meter.

A very distinct relationship is naturally traceable between the prime cost of a meter and its behaviour in service; the manufacturer's omnipresent difficulty being to produce an instrument of suitable accuracy and reliability *at a sufficiently low price*. In spite of every effort and years of experience on the part of makers, meters still form an expensive item in the capital outlay of an undertaking. The cost of the meter itself may vary from 30s. to £4 or £5, and the choice of a suitable pattern is further complicated by the fact that the capital equivalent of the energy losses in the meter may be £5-£10, or more, according to its design and the cost of energy.

For further information, I would refer "Collier" to Gerhardi's excellent treatise on "Electric Meters," and to many of the general sections of Edgcumbe's "Industrial Electrical Measuring Instruments."—"METERTEST."

Answer to Question 1231 (*awarded* 5*s.*).—In reply to the first portion of the query, it is advisable that all meters should be tested periodically; this may be easily done on consumer's premises by means of a stop watch and lamp load, counting the number of lamps on and assuming so many watts per lamp. This gives a rough indication as to whether the meter is approximately correct, and is quite near enough for most circumstances, but in addition to this test, which should be taken every time the meter is read, a complete test should be made at least once every 12 months in the supply station test room.

In the test room the meter should be tested at full and 1-20th loads, and the starting current taken. In most meters these tests prove sufficient, as, if the instrument is correct at the two loads mentioned it will be correct at all loads between. Referring to alternating current meters, an inductive load should be taken, say at 0·5 power factor, and should this inductive load prove very far out it indicates that the potential coil is shorted. This test gives a quick method of locating faults of this kind.

The jewels and pivots should be examined occasionally and if found faulty should be replaced; if jewel only is faulty both rewel and pivot should be replaced. This is necessary, as a pivot running on a cracked jewel would gather small particles of the latter, and if the jewel only be replaced the old pivot with the small particles of the cracked jewel will act as a cutting tool and very quickly destroy the highly polished surface of the new jewel. The dials should be examined for friction, and, if necessary, cleaned.

When these points have been attended to, and the meter in good running order it should be calibrated.

From the foregoing remarks it will be observed that it is necessary to keep a small stock of jewels and pivots, and in the case of a commutator type meter it is advisable to keep brushes and one or two spare armature drums and shafts with commutators; with these spares most repairs can be carried out in the test room without delay.

So far as giving an approximate cost of maintenance, it is somewhat difficult to quote average prices without knowing the make of meter referred to, but assuming the meter is of modern design and manufacture it may be taken that jewels will cost from 1s. to 1s. 6d. each; pivots 6d. to 9d. each; armature drums 6s.; spindles 3s.

The cost of calibration depends mainly upon the facilities for obtaining current, and the salaries paid to the meter testers. Assuming that it is possible to put up a number of meters for calibration at a time, say, tseting a row of one dozen at once, the average time of calibrating should not exceed one hour per meter for direct current ampere hour motor meters, while under similar conditions a wattmeter of the Thomson type would take a little longer, say, 1½ hours, and as most induction meters have to be tested on an inductive load as well as a non-inductive load, two hours each should be allowed for these.

The chief errors in mercury ampere hour meters of motor type likely to be met with in practice will be caused by short circuits, and these will have varying effects upon the meter depending upon its design. In the case of some instruments it will have the effect of demagnetising the permanent magnets, thus causing the meter to run fast; if the meter is will proportioned no damage should result, and at the present time most meter manufacturers guarantee their instruments to stand a short circuit test with a fuse of the same capacity of the meter in series. The demagnetising of the permanent magnets caused by short circuit more usually happens with a meter where a light load compensating device is used, but in an instrument without this device a short circuit test with a fuse of twice the capacity of the meter in series will not affect the calibration.

With a motor wattmeter the only troubles likely to be experienced are those caused by commutator, brushes, armature or jewels, and all these will be self-evident on examining the instrument.

In the case of induction meters any trouble with pivot jewels or clockwork may be very easily discovered; errors caused by short circuit in the current winding depend to a very large extent upon the design of the meter, but these are not very common, the chief trouble with meters of this type being in the potential winding, and, as before mentioned, a short circuit in this winding will be very easily shown by altering the accuracy on inductive loads, and it may be stated that in a meter where these coils are wound on two legs to the potential core the meter disc will revolve with the potential current only towards the leg which holds the shorted coil.

With regard to the last paragraph of the query, all that is really necessary is, as indicated above, to give the meter reasonable care and attention, with occasional examination, and no serious trouble should be experienced with any modern meters.

"Collier" does not state the type of meter he has in mind, but the foregoing is an endeavour to answer as briefly as possible, in the space allowed, the points referred to in connection with all modern types of instruments, excepting the electrolytic, and in regard to this latter it need only be said that trouble is usually experienced with the solution crystallising or in case of a heavy short circuit the meter is destroyed, in each of which cases a new element is wanted. P. D. Q.

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DREAMS OF THE FUTURE.

Probably the chief use of an inaugural address is to stir the imagination, to suggest possibilities, point out avenues of research and progress worth exploring. It is no doubt well occasionally to take stock of our present position, and take surveys of past efforts; but the essential duty of the President of an Institution is to point to the broadening vistas of the future. We may, therefore, congratulate Mr. S. Z. de Ferranti, for his inaugural address before the Institution last Thursday was in every respect mentally stimulating, pointing out the magnitude of the work that lies before us in the coming years. While in no way minimising the technical, economic and, above all, the political difficulties that await those who would become pioneers in that strange electrical age that lies before us, Mr. Ferranti rightly adopted the note of trust in and hope for the future. When he spoke of the wonders that abundant and cheap electricity could place at the disposal of the world, there was necessarily a note of romance. But no one could justly say that the note was forced, for as the President himself said within the last few years we have seen the telephone, phonograph, wireless telegraphy and telephony, the transmission of autograph letters and drawings developed, and, therefore, we have reason to expect even greater things in the immediate future. National, and indeed world-wide economics will force on these developments. Mr. Ferranti gives important figures demonstrating the terrible waste of our present methods of utilising coal. This is a topic which also occupied Mr. T. Harding Churton in his inaugural address as Chairman of the Yorkshire Local Section of the Institution. Mr. Churton gave a practical hint along what lines development may be expected. He said that while our largest steam set was one of 6,000 kw. development at Manchester, at the Delroy Station of the Detroit Edison Company (Michigan, U.S.A.), he

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had seen one of 14,000 kw., working perfectly smoothly, and with wonderful economy as regards fuel and attendance. Thinking over these two addresses, and looking back at those delivered before the British Association at Sheffield, we see that we have a multiplicity of counsellors and counsels, but the trend of all is towards developments on a large scale, but with a view to the conservation of material sources of energy and cheapening power. It is well for all concerned that those who are struggling to attain these ends should travel along different roads, for there must of necessity be many excellent ways of attaining a goal. Given economical methods of generating electricity on a large scale, and equally economical means of transmission, the visions that Mr. Ferranti has set before us would no longer appear so unattainable as present-day critics would have us believe. We may not, indeed, realise progress all along the line quite as the President suggests, but at all events the prospects before electrical engineering are immense. Necessity compels us to pay so much attention to minor and often rather sordid details, that it is well for leaders of the science and industry to call our attention to higher and broader things.

THE POWER EQUIPMENT OF COLLIERIES.

Glasgow Local Section of the I.E.E.

The opening meeting of the Glasgow Local Section of the Institution was held at Glasgow on November 8, when Mr. Sam Mavor, the Chairman for the session, delivered his inaugural address, the subject being "The Power Equipment of Collieries." Mr. Mavor said that to no industry had the services of electricity been greater than to coal mining. The demands for power at collieries had been greatly augmented in recent years. Formerly the requirements were only for ventilating, pumping, hauling and winding. Now developments in the practice of coal mining and in treatment of the product had entirely changed the conditions in respect of power supply. Acceleration in the various processes and operations and the further introduction of mechanical for manual means had contributed to this result. Competition in the market necessitated the supply of screened and washed coal of many sizes and power was absorbed in the treatment and improvement of the crude product of the mine. In screening plants, washeries, and frequently in bye-product recovery plant in connection with coking ovens the Germans had taken the lead.

Competition abroad and rising wages at home had compelled greater attention to the economies to be effected by efficient power equipment. To the electrical engineer was therefore now often allotted the duty of planning the electrical arrangements both for the production and distribution of power.

Only a little had so far been done in modernising power plant at our collieries, and the present extravagance in fuel consumption would be appalling if it were not the measure of the power engineer's opportunity.

On the Continent collieries were much more elaborately equipped, both as regards plant, buildings and the personnel of the management. The methods of colliery finance, the lower rates of wages, the longer working hours, and the higher prices obtained for the products gave greater latitude in expenditure, which on the Continent sometimes amounted to £1 sterling per ton of coal produced per annum, as against the average of 10s. in Britain. It was not the case, however, that the coal was handled by fewer men than in this country. The explanation of this was that the Continental colliery managers were engineers rather than pit-men, whereas our less highly educated managers were practical miners and could better plan their operations and coal handling plan so as to save labour. But they had been unduly parsimonious in mine equipment in Britain, and much improvement was possible in this respect without following the extravagant example of continental collieries.

Diversity of conditions gave room for variety of treatment. Turbo blowers, air compressors and pumps were rapidly displacing reciprocating plant. Here again the Germans had got the lead, and were now sending to the Rand turbo-air compressors of sizes up to 16,000 h.p. In France, where there was a preference for British wares, our turbine machinery was considered out-of-date. We were losing business in neutral and even friendly markets, because purchasers believed that our practice was not sufficiently advanced.

The mixed pressure turbine within the range of its application provided a most valuable means of reducing fuel consumption. The capital cost, however, with condensing accessories was relatively high and would be prohibitive where the value of the fuel was so low that the saving effected was insufficient to balance the capital charges on the plant.

Whether the current contracts between collieries and supply companies would be renewed on their present favourable terms to the latter remained to be seen. In the initial stages of development the supply of power at a moderate price from an outside source helped to keep down capital expenditure.

Notwithstanding the advantages of electric winding, its high cost had prevented its adoption in this country. Large concerns which could operate a group of pits from the same source of supply were best able to avail themselves of this. The restrictions imposed by power companies with regard to fluctuations in demand had hindered development in this connection.

After winding the pumping of water demands most power and reciprocating pumps, which until within the last few years were in common use on the Continent, have now been relegated to the place of being stand-bye plant to electrically driven high speed turbo pumps. That turbo pumps would become almost universal in Britain could not be doubted; their compactness, simplicity and efficiency ensure for them the premier place.

During the past seven or eight years experimental work had been in progress both in France and Germany in connection with turbo-air compressors, and orders for plants approaching 20,000 h.p. were now being captured by continental firms. A rich harvest awaited the successful pioneer of turbo-air compressors in this country.

The essentials in haulage driving were ample reserve of power and moderate or slow speeds. The slow speed motor best fulfilled these conditions, and the speaker urged that it be more largely adopted in preference to the continuous current high speed motor for such work. In auxiliary haulage there was great room for development along the line of displacing both hand and horse haulage. The author was of opinion that the rope haulage seen in this country was more economical than the locomotive haulage systems in use on the Continent and in America.

Reference was made to the percussive machine for drilling material too hard to yield to a tool with a cutting edge, and the difference between it and the Longwall coal-cutter was indicated.

The result of the increased demand for plant of high efficiency in mines was that colliery owners were now seeking to secure the best instead of the cheapest equipment, which in turn was an inducement to manufacturers to incorporate in their designs the results of recent experience and suggestion.

The report of the Departmental Committee which had recently gathered evidence from witnesses representing owners, managers, manufacturers and contractors, together with the proposed modification of the existing Home Office rules, was awaited with much interest. There was urgent need for experimental investigation into the whole subject of enclosure of motors and accessory apparatus so that the conditions essential to safety might be ascertained and authoritatively stated. An association of colliery owners had erected a gallery suitable for such tests at Altofts colliery, in Yorkshire, and experiments with regard to the origin and propagation of coal dust explosion were being carried out there. The author suggested that this gallery

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might be utilised for determining the conditions of safety requisite in electrical apparatus for use in situations where gas or explosive dust might accumulate.

With regard to the distribution of power by compressed air, the efficiency of the system seldom exceeded 25%; it was often much less.

In suitable seams coal cutters were a first-rate investment. The average saving effected by these machines in Scotland was at least 9d. a ton. It was satisfactory that in the manufacture and use of Longwall coal cutters British firms were so far ahead of foreign competition that they were alone in the field.

The increased output due to the coal cutter introduced the new problem of prompt removal of a large quantity of coal from a comparatively small area. This has brought the mechanical conveyor to the front, and this in turn had necessitated the provision of an uninterrupted service of trams, which meant reorganisation of the entire haulage arrangements. There must be synchronism in the cycle of operations.

Machinery in mines had not lessened the hazard of mining to the individual miner, and it was pointed out that in respect of rescue and ambulance equipment British collieries were behind most continental mining districts. The position was being improved, however.

Machine mining as applied to thin seams was more expertly conducted in Scotland than anywhere else. Colliery managers in Scotland had distinguished themselves by devising underground conveyors.

Mining in the future would be increasingly mining by machinery, and the first requisite in designing such plant was first-hand knowledge of the working conditions. The results of slovenliness or ignorance in matters of detail were serious and bound to be discovered. In no other department of electrical work was carelessness so dangerous or the benefits of thoroughness more apparent than in colliery work.

On the motion of Mr. W. W. Lackie, Mr. Mavor was heartily thanked for his address. Mr. Lackie said Mr. Mavor's firm had been pioneers in electrical work in Scotland, and no account of their industry would be complete which omitted Messrs. Mavor & Coulson's share in its development.

THE POLYPHASE INDUCTION MOTOR.*

By C. F. Smith, M.I.E.E.

In a paper on "The Irregularities in the Rotating Field of the Polyphase Induction Motor," the author pointed out that the want of uniformity in the rotating field of the polyphase induction motor was due chiefly to the following causes:—(1) Non-sinusoidal wave-form of the supply voltage. (2) Disposition of the stator winding in a limited number of slots. (3) Variation of the air-gap reluctance, due to the varying position of the teeth and slots of the rotor in relation to those of the stator. (4) Want of uniformity of the air-gap, due to the rotor being out of centre. (5) The effect of want of proportionality between magnetising current and flux might also be mentioned, although this matter was of less importance.

The results of the experiments described in the paper, which were given in numerous figures and curves, and were carried out at the Manchester Municipal school of Technology, were based on measurements of the electromotive forces induced in special search coils wound on the stators of two induction motors, so as to embrace portions of the air-gap flux of the motors. These search coils were disposed in various positions round the stator, and were wound so as to embrace different numbers of stator teeth. After describing the methods of experiment employed, the paper dealt with the voltage induced in stator windings of a stationary motor; voltage in rotor windings; effect of grouping coils; effect of ratation on stator flux; effect of rotation on rotor flux; value of flux pulsations; effect of flux pulsation on coil voltages; oscillograph records of voltage in search coils; and confirmatory tests on another motor.

* Abstract of paper read before the Manchester Local Section, Institution of Electrical Engineers.

With regard to the effect of an uneven air-gap, the stator winding of an induction motor was necessarily formed of several coils connected in series, and the voltage applied to the stator would be divided equally between these coils, if the induction in each were the same. If, however, the air-gap of the motor were not uniform, the voltage would be distributed between the coils approximately in the ratio of the flux densities at the points where the coils were situated, roughly in the inverse ratio of the air-gap lengths at these points. It must frequently occur that through wear of the bearings and other causes the air-gap of an induction motor was not uniform all round the rotor, and the author believed that it was not generally realised how few of these motors had an air-gap which was sufficiently uniform to give an approximately constant induction in all directions. Mr. Miles Walker had told the author that with liberally designed bearings the wear should be practically nil, although cases did arise where unfair conditions had caused the rotor to sink sufficiently to touch the stator. Large induction motors were made with adjustable bearings, and the air-gap was supposed to be corrected before it had become reduced by more than 15%. He had found in ordinary shop practice that the air-gap would sometimes be 15 or 20% out of truth. In motors examined by the author, in actual service, an even larger discrepancy had been found. It would be easy to over-estimate the importance of this want of uniformity of the field, but it might be worth while to enumerate the disadvantages likely to arise from it, viz.:—(1) The magnetic drag on the rotor in the direction of the strongest field; (2) the concentration of the applied voltage in certain coils of the winding, producing unequal dielectric stresses; (3) increased hysteresis and eddy-current loss in the teeth subjected to high induction; (4) unequal voltages in the phases of the rotor resulting in an unsymmetrical distribution of currents, varying with the frequency of rotation. Evidently these points were all arguments in favour of using as large an air-gap as possible in order that an unavoidable inequality might have a small relative value. An uneven air-gap might produce inequality in the rotor phase voltages, especially where the number of pole-windings was small. The position of the search coils did not permit of an examination of the actual irregularities introduced in the rotor voltage or current by rotation in an air-gap of varying length. From measurements of the rotor voltage and current with the rotor stationary and in different positions, a variation of about 5% was found, most of which was probably due to this cause. It seemed highly probable that an unbalancing of the rotor phase voltages would be accompanied by an increase in the losses of the motor, and that the greater the number of closed circuits in the rotor winding the greater would be the liability for such losses to occur. Thus greater losses might be expected from this cause in a motor with mesh-connected rotor than in a star-connected rotor, and greater losses still in a squirrel-cage motor having the same degree of eccentricity. In this connection it might be worth while to refer to a paper by Messrs. Hillebrand and Charters, in which they described experiments upon the effect of an out-of-balance in the voltage applied to the stator of an induction motor. They found that the output of the motor was decreased considerably by inequality in the voltage or power factor of the phases of the supply. A voltage out-of-balance of 5% produced something like 15% decrease in the output of the motor.

Discussion.

Mr. W. Cramp, referring to the description of the 15 h.p. motor used in the tests, said he thought it was a fortunate circumstance that while the stator had 60 slots, the rotor had 48, giving a G.C.F. of 3, which was unusually large under the circumstances. This would affect the results all through the paper. In the case of the 6-pole Siemens motor also tested, the G.C.F. was not quite so high, and therefore the results would be somewhat modified. He thought the fact that the winding shown in Fig. 1 was a hemitropic one should have been emphasised, as again, in his opinion, the question of windings would affect the results given all through. Regarding the effect of flux pulsation in the coil voltages, he thought the change of flux would be due to the number of "correspondences" between rotor and stator teeth, and that it would not be dependent upon the number of entrances and exits of the teeth. Dealing with the effect of unequal air-gap, he thought the fact that really the gap

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was a double one had been lost sight of. In his view, the closing up on one side was compensated for to some extent at any rate, by the widening of the gap on the other sides. He had recently been comparing the electrical particulars of a number of induction motors by different makers of repute, and he had found that for the same output there was a variation in air-gap of 100% between the various designs. This was a fact which buyers should carefully note when comparing prices. It was easy to make a cheap motor by cutting down the air-gap excessively. One firm provided bearing arrangements by which the rotor could be centrally adjusted to compensate for wear. This was an idea which, he thought, might be adopted by others with advantage to the user.

Prof. MARCHANT mentioned that at Liverpool University some tests on the same points dealt with in the paper had been made by Mr. Lawson, whose results showed that the pulsation losses were about doubled at full load. He thought the effects due to the uneven air-gap were most important. One of these effects—magnetic drag on the rotor—depended simply on the hysteresis loss in the rotor, and was therefore not so important as another effect—the increased hysteresis and eddy-current loss in the teeth subjected to the high inductions on the narrow side of the gap. The concentration of the applied voltage in certain coils of winding, and the resulting production of unequal dielectric stresses, which was another effect of unequal air-gap, he did not consider an important matter, but the fourth effect—the unequal voltages in the phases of rotor resulting in an unsymmetrical distribution of currents, according to the frequency of rotation, he considered to be of considerable importance. As was pointed out later on in the paper, it might produce a considerable reduction in the output of the machine and at the same time produce greater losses.

Mr. T. F. WALL: The results given in Mr. Smith's paper confirmed results he had got in another way. His experience was that the customer never used the adjustable bearing to set the air-gaps centrally, where it was provided. In any case the measurement of air-gaps was a very difficult thing. In the new machine the excess of varnish settled down to the bottom and came on to the lower teeth of the stator, thus making the air-gap there apparently less than it really was.

Dr. ROSENBURG: Dealing with the question of air-gaps, he pointed out that the size of air-gap had a great effect of the power factor of the machine. He considered that 95% of the breakdowns of electrical machinery were due to mechanical causes, and were not electrical. The electrical tests did not really show the quality of the machine, and very often it was found to be the "good" machine (judged from the electrical tests) which broke down, while the "bad" machine (on the same standard) turned out best. Regarding the heavy equalising currents set up by unequal air-gaps in a squirrel-cage rotor, mentioned by Osnos and referred to in the paper, he doubted if tests confirmed this. Tests on D.C. machines showed very little equalising current, a fact which caused him to doubt the truth of theory put forward.

Mr. J. FRITH: Referring to the unequal air-gaps, he pointed out that if its effect were really going to be serious, the coils could be connected in parallel, and not in series, across the full voltage. This was an alternative to the large air-gap. With regard to the reduction of output due to eccentricity of the rotor, he wanted to know if the figures quoted referred to reduction of actual breakdown output or to reduction of rated output on the heating basis.

Mr. ALDOUS: The reduction of output should not be a serious matter, as the extra losses due to the eccentricity of the field were not very large, and were principally the effect of the stator teeth, which could be very easily got rid of. On high tension motors parallel winding was impossible. The actual heating of the motor by the extra losses consequent on eccentricity was not increased appreciably. As to bearings, he would endorse Mr. Miles Walker, the wear of good bearings would be nil. When the bearings were really designed for the work, that the motor had to do, they did not wear. Where wear did take place, it was usually a matter of lubrication or some other mechanical detail. He thought "creeping speeds" and bad starting points on induction motors were practical problems on which the paper would be useful.

Mr. C. F. SMITH (reply): Mr. Cramp had criticised his method of adding voltages, assuming that the effects depended on tooth saturation, but as a matter of fact they did not, and would still be there if the iron were replaced by air. It was therefore quite correct to add the voltages as he had done. The pulsations were not very greatly different in the two motors. The question of G.C.F. probably had something to do with the matter, but not by any means so much as Mr. Cramp had suggested. The calculation of the flux pulsation by the reluctance, as Mr. Cramp would do it, or as he had done it by the number of teeth, came to the same thing, and he had at first sometimes used one way, sometimes the other. Replying to Mr. Frith, the figures he gave for reduction of output were taken from a rather vague paper, but he thought it was taken on the reduction in rated output due to heating.

STEAM SPECIALITIES.

At the late Manchester Exhibition.

As might have been expected at a mechanical and engineering exhibition, there were many things of special importance to the engineer interested in prime movers.

Foremost among the exhibits appealing to the user of steam engines must be mentioned that of Messrs. James Airey & Sons, of Bellerby-terrace, West Hartlepool, who showed the patent packing rings designed and perfected by Mr. James Airey, the well-known consulting marine engineer. These rings have been gradually brought to a state of perfection, as the result of some years' continuous experimenting under working conditions, carried on simultaneously on a number of steamers. The tests show that invariably these rings have proved to be perfectly steam-tight, even against 210 lbs. continuously and yet practically frictionless; these two very desirable qualities making a considerable saving in steam consumption, and consequently in the coal bill. While the bulk of the rings now in use are working in marine engines on steamers, land engineers who have seen the tests have not been slow to appreciate the importance of this latest development, and already there are several sets working in mill-engines, high speed sets in generating stations, etc. Reference to the illustration shows that this ring is somewhat different in design to the conventional form—it owes its superior qualities to this fact. It will be noticed that the complete piston ring consists of three separate rings built up on one another, the centre ring (which is deepest) is of the ordinary metal and is rabbetted on its top and bottom edges as shown. The two outer rings, one top and one bottom, are of, bronze, and each is provided with a ridge, as shown, fitting into the rabbetts in the solid centre ring. It will be noticed that the bronze rings are cut at one point. This is to allow for the greater expansion of the bronze when the rings are heated up. The circular dots noticed in the rabbett are very small springs to keep the bronze rings easy in it. The large springs usually depended upon in piston and piston valve packing rings, to keep them tight against the cylinder walls, are completely done away with, and it is due to this fact that the Airey type of ring is so uniformly successful, and gives such constant results, even after several years' service, and is so frictionless.

An exhaustive series of tests have been made on the same engines, working under the same conditions, but sometimes with the Airey rings and at others with the best representatives of the other types instead. Invariably it has been found that with the Airey rings there was a considerable reduction in the total indicated h.p. developed by the engine to perform the same useful work as with the other rings. This is clear proof that with these rings friction is reduced to a very small amount; in fact, after four years' service the tool marks have been seen in the rings as fresh as ever. Partly owing to the reduced friction and consequent smaller gross engine output, but principally due to the perfect steam tightness, a considerable reduction in the coal burned has always been obtained with the Airey ring in use, even in many cases where the cylinders have been very badly worn.

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An actual comparison taken on a triple expansion marine engine is particularly convincing. In this case the cylinder was very much out of truth—the diameter at the position of half-stroke being 5/16″ greater than at full.

A = ordinary packing rings; B = Airey's bronze and metal segments.

	A.	B.
Average speed	9½ knots	10 knots
Consumption of coal per day ..	25½ tons	19¾ tons

After boring out the cylinder and making it parallel, and fitting bronze rings to solid metal ring. :

	A.	B.
Average speed	10 knots.	10¾ knots
Consumption of coal per day ..	23½ tons	18½ tons.

The test was taken over 12,000 miles in each case, and the r.p.m. was constant in both cases. Corresponding savings would, of course, result from the adoption of these rings in central station engines. Another interesting claim in connection with these rings is that they make a specially designed low pressure reciprocating engine to work off exhaust steam from an ordinary engine, or even turbine, a commercial possibility, since the friction is so much reduced and steam tightness is so great. Mr. Airey suggests such an engine in connection with turbine steamers to take the place of reversing turbines (all the reversing being done on the low pressure reciprocating engine), and help the main turbines when going ahead, by working off their exhaust. All this is, of course, applicable to the central station man, and probably some interesting developments on these lines will take place before very long.

Clarke Chapman's had a model of the Woodeson well-known water-tube boiler with their latest features.

The latest thing in steam generation was perhaps the Fletcher Patent Thermal Boiler Feed, which is being put on the market by William Boby, of Salisbury-house, London, E.C.

AIREY PACKING RINGS.

Briefly, his system consists in passing all the boiler feed through the first boiler of the battery. The temperature of feed water before it enters the boilers is arranged to be such that the feeder boiler will always be producing steam. Consequently the water feed into the remaining boilers will be at the temperature of the steam at the working pressure. The best results are got when there are not less than four boilers in the battery, but practical tests seem to show that even with two Lancashire boilers when worked on the Fletcher system, there is a substantial increase in the amount of water evaporated per lb. of coal, of about 12–15 per cent., while the rate of evaporation is, as might be expected, more rapid—about 20 per cent. greater.

Tests taken on a battery of five furnace gas-fired Rastrick boilers, each having a heating surface of 460 sq. ft., after running some years on the ordinary system, gave very striking results after being changed over to the Fletcher system. For instance, the highest evaporation ever got with the original method of working was 350 gallons per hour, but with the Fletcher 800 gallons were evaporated per hour, with the feed in both cases at 120 degrees F., and all other conditions similar.

The mean of some tests on this battery taken last July are as follows :—

	Average rate of evaporation in gals. mean tests.	Evaporation per hr. in lbs of water per sq. ft. of heating surface.
Fletcher's	471	10·1
Ordinary	285	6·16

The advantages claimed for the system are economy of coal consumption, with increased rate of evaporation, at the same time readier response to sudden demands and less tendency to prime. It is claimed the durability of the boilers is increased, due to the temperature distribution through them, but one is inclined to doubt this in the case of the first boiler, where the stresses certainly seem to be all concentrated. No doubt these are all allowed for in the design of the system. Scale tends to settle in the first boiler and not in the others, so that cleaning is reduced. The system is equally applicable to either new or existing batteries of all types.

As most steam engineers are aware, the regulation of the air supply to a boiler furnace has a very important effect on the coal consumption. An insufficient supply of air causes a smoky chimney and loss of fuel, while too much air also means increased coal consumption. It has been found that in ordinary boilers, if the flue gases contain 15 per cent. CO_2, the maximum value is being got from the fuel consumed, while if only 10 per cent. CO_2 is present one cwt. per ton is being wasted. If 7 per cent. CO_2, then two cwts. per ton.

The "Auto" Recorder Company, of Leicester, showed an exceptionally well designed and substantially constructed CO_2 Recorder, for boiler-house use, with an accuracy within ·5 per cent. This instrument, which may safely be handled by a navvy without sustaining any damage, requires only about three minutes' attention daily.

Another exhibit shown by this firm was a set of fire-bars taken from one of their "Midland" patent controlled draught furnaces after several years' service. No signs of wear were perceptible.

This furnace may be applied to any boiler without in any way altering it. Among the advantages claimed are that the right amount of air required (as shown by the CO_2 Recorder) to burn the coal to the best advantage is admitted by adjustment. Cheaper coal may be employed without smoke, while the steaming power is increased with less straining of the boiler (very little cold air being drawn in). The "Auto" Company are prepared to instal their furnaces on trial and give full guarantees of definite reduced coal saving.

The Lea Recorder Company's exhibit, which has already been described, included a new integrating meter in addition to the older features, which are now so well known. This instrument is now considered to be an indispensable part of the equipment of an up-to-date steam plant.

SCOTTS OLD BOYS.

The annual re-union of "Scotts Old Boys" was held on Saturday evening, at the "Villa Villa" restaurant, Gerrard-street, W., under the presidency of Mr. C. N. Russell (Shoreditch). These re-unions, which are marked by extra-ordinary enthusiasm, are attended by members from all parts of the country. The dinner was followed by speeches and general conviviality, with some excellent entertaining by Miss Ruby Wilson and Mr. Wilson James. The society, which is informal, consists of men who were apprentices or pupils at Scotts Works, Hammersmith and Acton, in the eighties and early nineties. Many of the "old boys" have attained eminence in the electrical profession, whilst others have been less fortunate, but on these occasions all meet as in the old days, upon terms of absolute equality. The secretary, Mr. H. Marryat, 28, Hatton-garden, E.C., will be glad to hear of the addresses of any such with whom he many not be already in communication.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

AMERSHAM.—Parliamentary notices were forwarded as to the Uxbridge Electricity Supply Company applying to the Board of Trade on or before December 21 for a provisional order authorising them to transfer the undertaking to Callender's Cable & Construction Company. This company also gave notice of their intention to apply to the Board of Trade for an order authorising them to supply electricity for all private and public purposes within the rural district of Amersham.

LLANELLY.—Mr. J. C. Howell has reported to the Urban Council that the electric light undertaking will be ready about the middle of December, and the tramway in April.

MORLEY.—The Borough Electrical Engineer reports that the number of units consumed during September was only 12,767, as compared with 14,082 in September of last year. This he attributes to the growing use of metallic filament lamps. One stores had secured an economy of 577 units in one quarter by installing Osrams, bringing down their consumption to 2,582 units.

PORTRUSH.—The Council will take steps as early as possible to obtain an electric lighting order from the Board of Trade.

ST. ANNES-ON-SEA.—For the year ending March 31 the income of the municipal electricity department was £10,697 (of which £5,536 was for private lighting, £1,599 for public lighting, and £2,982 for traction). The expenditure was £6,054. Out of the gross profits £1,000 was paid in aid of rates and £242 placed to reserve.

TIPPERARY.—The Board of Guardians have decided to instal electricity at a cost of £2,280. Mr. Lawless, the engineer, has been instructed to draw up specifications and to issue applications for tenders for the building of a power house and the electric installations.

WOLVERHAMPTON.—A Local Government Board inquiry has been held into the application for powers to borrow £20,000 for electricity extension works and refuse destructor. At the suggestion of the Inspector the amount was reduced to £14,250, various sums, such as £1,000 for services to consumers, to be paid out of revenue.

OVERSEAS.

CIUDAD, BOLIVAR.—Considerable works in connection with the harbour, and also the building of the Custom House, are to be undertaken here. Electric light is to be used throughout, and the top of the Custom House is to serve as lighthouse. Cranes, etc., will be wanted. The name and address of the Controller can be obtained from the Commercial Intelligence Branch of the Board of Trade.

JUJUY, ARGENTINE.—The hydro-electric power house at Jujuy, property of Messrs. Alviña & Pitto, has been purchased by Mr. C. Seguin for $60,000.

PALMERSTON, NEW ZEALAND.—A conference of Chambers of Commerce is to be held to consider a scheme for harnessing Lake Waikaremoana to obtain electric power for lighting purposes.

SORRENTO, ARGENTINE.—Work has commenced on the new power house of the Rosario Electric Light Company. It will have a capacity of 10,000 h.p. and will be fitted with steam turbines.

TRACTION.

HOME.

LONDON, KENSINGTON.—The Borough Council have decided to approve the London County Council's scheme for a tramway between Harrow-road and Wood-lane.

PORTSMOUTH.—The Board of Trade have recently confirmed the undermentioned Order made by the Light Railway Commissioners:—Portsmouth and Hayling Light Railway (Extension of Time) Order, 1910, reviving the powers granted by the Portsmouth and Hayling Light Railway Order, 1905, for the compulsory purchase of lands, and extending the periods limited by that Order for the same and for the completion of the light railway and works thereby authorised.

WALTHAMSTOW.—The Council have decided to issue tokens for use on the tramways. They will be sold in packets of 13 penny or 26 halfpenny tokens for 1s., and for 5s. worth and upwards, 10% or 6d. in the 5s., discount will be allowed.

WEST FIFE. Trial runs have been made on the recently constructed branch of the West Fife Tramways, extending from Cowdenbeath to Kelty, a distance of about 3 miles. It is expected that the Board of Trade inspection of the line will take place on November 15, after which the conveyance of passengers will be begun.

WESTON-SUPER-MARE.—The Board of Trade have recently confirmed the undermentioned Order made by the Light Railway Commissioners:—Weston-super-Mare Junction Light Railway Order, 1910, authorising the construction of a Light Railway in the Urban District of Weston-super-Mare, in the county of Somerset, connecting the Weston, Clevedon and Portishead Light Railway with the Tramways of the Weston-super-Mare and District Electric Supply Company, Ltd.

YORK.—Mr. J. W. Haine, general manager of the Corporation Tramways, has devised an indicator which shows the exact position of every tramcar at any given moment. The instrument has been constructed by a local clockmaker, Mr. Newey.

OVERSEAS.

LOCARNO.—The Swiss Government have granted a concession to the Società delle Tramvie Elettriche Locarnesi for the construction and working of an electric railway from Gordola to Bellinzona. The line will be about 8 miles in length, and the cost of construction is estimated at 992,000 francs (£39,680).

MADRID.—The Direccion General de Obras Publicas announce that Don Ramon Cotarelo Rodriguez has applied for a concession for the construction and working of an electric tramway from La Calzada to Puerto el Musel.

ONTARIO.—A company intend to construct an electric railway from Niagara Falls to the Porcupine gold mining district. It is hoped to complete 10 or 15 miles of the line this winter and the remainder next spring. The name and address of the company can be obtained from the Commercial Intelligence Branch of the Board of Trade.

PIACENZA.—The Italian Government have granted a concession to the Società Imprese Elettriche Piacentine for the construction and working of a new standard gauge electric tramway in Piacenza from Piazza San Savino to Molino degli Orti.

SALTA, ARGENTINE.—A concession for electric tramways in the City of Salta has been granted to Mr. A. Barré.

ST. MORITZ.—The Swiss Government have granted a concession to the Société de Développement de St. Moritz for the construction and working of an electric funicular railway from St. Moritz to l'Alpe Giop. The line will be 983 metres (1,075 yards) long, and the cost of construction is estimated at 420,000 francs (£16,800).

YOKOHAMA.—Japanese Railway Board have decided to lay down a narrow gauge electric tramway alongside the railway track from Yokohama to Tokio. This tramway may subsequently be extended to Kozu and Kamakura.

COMPANIES' MEETINGS AND REPORTS.

PROVINCIAL TRAMWAYS COMPANY.

Writing to the secretary of the Stock Exchange, under date of November 9, the secretary of the Provincial Tramways Company, Ltd., states that "the accounts of the company for the financial year ended September 30, 1910, subject to final audit, have been submitted to the directors, and they will recommend a final dividend of 9d. per share on the ordinary £1 shares of the company. This dividend, with 8d. per share paid in June last, will make a total dividend of 1s. 5d. per share on the ordinary £1 shares in respect of the financial year ended September 30, 1910. Since the commencement of the financial year (October 1, 1909) the shareholders, at extraordinary general meetings held on February 11 and March 4, 1910, passed resolutions converting the £10 ordinary shares into five shares of £1 each, and the reduction of the ordinary share capital was in due course approved by the High Court. The dividend paid for 1908 and 1909 upon the £10 ordinary shares was 7s. per share, and the dividend for the financial year ended September 30, 1910, is equivalent to a dividend of 7s. 1d. upon the old £10 share. Before declaring the dividend the directors have set aside £8,000 for reserve and depreciation in respect of various undertakings the property of the company. The directors have also set aside £350 towards writing off the expenses of the issue of the debenture stock of the company, and £217 the costs and expenses of the reduction of the ordinary capital. The amount of undivided profit brought into the account on October 1, 1909, was £2,686, and the undivided profit to be carried forward on September 30, 1910, will be £2,831."

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FINANCIAL NOTES.

EAST INDIA TRAMWAYS.—The directors of the East India Tramways Company, Ltd., have declared a dividend of 5% on the Ordinary shares and 1½% on the Deferred shares for the year to July 31, carrying forward £176.

* * *

BRITISH INSULATED & HELSBY CABLES.—The directors of the British Insulated & Helsby Cables, Ltd., have authorised Parr's Bank and the Bank of Liverpool to receive applications at par for £200,000 of 5% Mortgage Debenture stock, being part of an authorised issue of £500,000, which will be secured by a trust deed creating a specific mortgage to the trustees for the Debenture stock holders on the whole of the company's freehold and leasehold property and a floating charge upon the whole of the undertaking and other assets of the company both present and future, subject only to the existing issue of £700,000 First Mortgage Debenture stock. The trust deed will further provide that the company shall not create any further mortgage or charge ranking in priority to or pari passu with the Debenture stock. This will be redeemed on January 1, 1925, at par, but the company reserves the right at any time after December 31, 1915, on giving six months' notice to redeem the whole or any part at 102½%, and in the event of liquidation of the company the stock is redeemable at that price. The company was formed in 1897, and in 1902 amalgamated its business with that of the Telegraph Manufacturing Company, Ltd., of Helsby. Since the amalgamation the operations of the company have been largely extended, and in view of the present and future requirements of the business the directors have decided to make the present issue. The subscription lists will close on or before the 17th inst.

LINCOLN.

The headmaster of the Municipal Technical School reports that, through the interest of the directors of the engineering firms in the city, it had been possible to arrange day classes for a limited number of engineers' apprentices, who were to be nominated by their employers, and to be allowed to have Monday off in each week during the session, without loss of wages. Twenty-five apprentices have joined the classes.

EDUCATIONAL.

ANDREW CARNEGIE RESEARCH SCHOLARSHIP.

A research scholarship or scholarships, of such value as may appear expedient to the Council of the Iron and Steel Institute from time to time founded by Mr. Andrew Carnegie (Past-President), who has presented to the Iron and Steel Institute 89 one-thousand dollar 5 per cent. Debenture Bonds for the purpose, will be awarded annually irrespective of sex or nationality, on the recommendation of the Council of the Institute. Candidates, who must be under 35 years of age, must apply on a special form before the end of February to the secretary of the Institute. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations. The appointment to a scholarship shall be for one year, but the Council may at their discretion renew the scholarship for a further period instead of proceeding to a new election. The results of the research shall be communicated to the Iron and Steel Institute in the form of a paper to be submitted to the annual general meeting of members, and if the Council consider the paper to be of sufficient merit, the Andrew Carnegie Gold Medal shall be awarded to its author. Should the paper in any year not be of sufficient merit, the medal will not be awarded in that year.

THE INSTITUTION OF SIGNAL ENGINEERS.

The growing importance of signalling as one of the functional divisions of railway working has led to the formation of an Institution of Signal Engineers. The new Institution, which has been duly incorporated, held its first general meeting at Birmingham on the 8th inst. The president, Mr. A. T. Blackall, the Signal Engineer of the Great Western Railway, in his inaugural address, laid emphasis on the modern conception of signalling. It was concerned, he said, not merely with the installation of apparatus, but with the consideration in a comprehensive manner of all the varying conditions which have to be met and with the working out of schemes which should be appropriate from every point of view. Hence the co-ordination of the various elements of the signalling system is an essential necessity to orderly and economical development. We should thus try to abandon the arbitrary distinctions which have been made in the past between outdoor signalling, block-signalling and so on and recognise that all these are merely parts of a uniform system, the object of which should be to provide for the safety of traffic movements in the most efficient and most economical manner. It would be the aim of the Institution to assist in the training of men who can deal with signalling in this comprehensive manner. In fulfilment of this idea the Institution included among its membership those engaged in both the manual and electrical or telegraph branches of the work.

The address of the president was followed by a paper by Mr. A. H. Johnson, Signal and Telegraph Engineer of the London and South Western Railway, on "Detection."

Information regarding membership in the Institution may be obtained from the honorary secretary, Mr. C. B. Byles, L. and Y. Railway, Manchester.

DIARY.

FRIDAY, NOVEMBER 18.

INSTITUTION OF ELECTRICAL ENGINEERS (Glasgow Students' Section).—At the Glasgow Technological College, at 8 p.m.

FARADAY-HOUSE OLD STUDENTS' ASSOCIATION.—At the Holborn restaurant (Council-room), at 8 p.m. Annual smoking concert.

MONDAY, NOVEMBER 21.

JUNIOR INSTITUTION OF ENGINEERS.—at 7.30 p.m., at the Caxton-hall, Westminster. Fourth lecture on "The Law Relating to Engineering," by Mr. L. W. J. Costello, M.A., LL.B.

LEEDS UNIVERSITY ENGINEERING SOCIETY.—Mr. Robert Buchanan on "Recent Development in Foundry Theory and Practice."

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, at 8 p.m. Cantor Lecture I., Mr. C. R. Darling on "Industrial Pyrometry."

ELECTRO-HARMONIC SOCIETY.—At the Holborn Restaurant (King's-hall), at 8 p.m. Concert (Ladies' night).

INSTITUTION OF ELECTRICAL ENGINEERS (Newcastle Local Section).—At the Armstrong College, at 8 p.m., Mr. J. G. Wilson on "Electric Winders."

TUESDAY, NOVEMBER 22.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Section).—At the Physical Laboratory, University of Manchester, at 7.30 p.m. Mr. H. J. Harrison, on "Street Lighting by Modern Electric Lamps."

WEDNESDAY, NOVEMBER 23.

SOCIETY OF ARTS.—John-street, Adelphi, at 8 p.m. Sir Henry H. Cunynghame on "Methods of Detecting Fire-Damp in Mines."

THURSDAY, NOVEMBER 24.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—At the Institution, Victoria Embankment, at 8 p.m., Mr. H. T. Harrison on "Street Lighting by Modern Electric Lamps."

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, Imperial Institute-road, South Kensington, at 5 p.m., Dr. A. Russell on "The Electric Stress at which Ionisation begins in Air."

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

CONTRACTS OPEN.

HOME.

BISPHAM-WITH-NORBRECK.—The Urban Council invite tenders for (a) gas engines, gas producing plant and dynamos; (b) switchboard, balancers and boosters; (c) storage battery; (d) mains (overhead and underground). Specifications, etc., obtained (deposit two guineas), Mr. J. W. Tickle, Clerk to Council, Bispham, Blackpool. November 21.

LONDON.—The Port of London Authority invite tenders for the supply of materials and stores for twelve months ending December 31, 1911. Specifications from the Manager of the Stores Department, 106, Fenchurch-street, E.C. November 19.

LONDON, FOR CALCUTTA.—The Calcutta Electric Supply Corporation, Ltd., invite tenders for the supply of overhead electric and hand travelling cranes, with rails, conductors, motors, etc. (Specification No. 9). Particulars from The Secretary, Calcutta Electric Supply Corporation, Ltd., Salisbury-house, London-wall, E.C. December 1.

LONDON.—The London County Council invite tenders for the overhead electrical equipment on the trolley system required in connection with the construction of the new tramways, approximately 1 mile in length, between Putney-bridge and Wandsworth High-street. Specifications, bills of quantities, form of tender, etc., from the Department of the Clerk of the Council, County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of £2. December 6.

WALTHAMSTOW.—The District Council invite tenders for one 1,000 kw. mixed pressure turbine with tandem generators of 500 kw. each, complete with surface condenser and pipe work. Specification, etc., obtained (deposit £2), Mr. G. R. Spurr, Electricity Works, Walthamstow. November 25.

OVERSEAS.

AUSTRALIA.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on December 6, for the supply of (1) cable testing instruments (Schedule No. 336) and (2) 6,000 jacks (Schedule No. 385). Tenders will be received at the office of the Deputy Postmaster-General, Adelaide, up to noon on December 29, for the supply of (1) battery and line material, and telegraph and telephone instruments (Schedule No. 147), and (2) telephone cable (Schedule No. 149). Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to 2.30 p.m. on January 4, 1911, for the supply of 3 multiple-magneto switchboards (Schedule No. 45). A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to each of the above contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

BRISBANE.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up to noon on January 4, 1911, for the supply of (1) poles and ironwork (Schedule No. 141), and (2) 17 magneto switchboards (Schedule No. 142). A deposit will be required with each tender. Local representation is necessary. January 4.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham House, Old Broad-street, E.C., and Central House, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a *bona-fide* tender.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 200 contacts, plug seat, and 2,350 condensers (Schedule No. 402). A deposit will be required with each tender. Local representation is necessary. January 10.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

BOURNEMOUTH: Mr. J. E. Beale, Bournemouth. Rebuilding business premises.

FALMOUTH: Mr. E. E. Armitage, Town Clerk. Pavilion in Gyllyngdane Gardens.

FROME: Mr. A. J. Pictor, Bruton. Manual Instruction Rooms, at Frome County Schools.

LEEDS: Mr. J. Graham, Education Secretary, Leeds Corporation. Two hostels for male students at Beckett's Park College.

MERTON: Mr. J. S. Brocklesby, architect, Bank-chambers, Merton. Church.

PLYMOUTH.—Mr. F. A. Clark, architect, 83, Old Town-street, Plymouth. Barracks for Territorials at Millbay.

ROMFORD: Mr. M. Bunney, architect. Modern house and cottage exhibition, Gidea Park, Squirrels Heath.

NOTES.

Electrical Contractors and Municipal Engineers.

We are glad to learn that the preliminary conference between the officials of the Incorporated Municipal Engineers' Association and the Electrical Contractors' Association (Incorporated) has proved quite satisfactory to both sides. A further meeting is to take place on December 8. There are many outstanding points of difference between the general body of contractors and municipal electrical engineers, but these differences mainly arise through misunderstandings, as it is obviously to the interests of all concerned to promote the extended use of electricity. It is, therefore, well that such conferences should take place, which should remove much unnecessary friction.

"D.P." Batteries go Overseas.

It is pleasing to find that the "D. P." Battery Company, Ltd., are participating freely in the increased national exports. They have been very successful in their oversea trade during the past month. Among others, batteries have been shipped to the Transvaal (two), India, Siam, Queensland, Newfoundland, and Canada. The firm's home trade has also been excellent, the recent contracts including the complete replating of another make of battery at the Charlotte-street sub-station of the Chelsea Electric Company.

Motor Converters.

Messrs. Bruce Peebles & Company, Ltd., have recently received one of the largest orders placed for a number of years in Great Britain for sub-station and electrical

OSRAM·LAMPS

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machinery. This order is for 16 Peebles Motor Converters (La Cour patents), each of 475 kilowatt capacity, running at a speed of 500 r.p.m., the alternating current ends being wound for three-phase 50 cycles 6,000-6,600 volts, and the continuous current ends for 450 to 550 volts. The machines are to convert from alternating to continuous current, or vice-versa, and are also to be used for supplying a three-wire continuous current network, for which their motor converters are specially suitable.

The contract was publicly advertised and tenders were invited for induction and synchronous motor generators, permission being given to tenderers to offer alternatives for rotary converters, or motor converters, for which latter Messrs. Peebles hold the sole manufacturing rights in Great Britain and its colonies. After the most careful enquiries had been made by the consulting engineers (although Messrs. Peebles' machines were more costly than a number of other offers for motor generators and rotary converters) the contract amounting to £25,000 has been placed with them. The importance of the order is better understood when we know that the consulting engineers are the eminent London firm, Messrs. Kennedy and Jenkin, and that the purchasers are the Calcutta Electric Supply Corporation, Ltd., the plant requiring to be designed to work under the severe climatic conditions which obtain in India.

"Tantalum" and "One-Watt" Lamps in a London Tube.

"Tantalum" lamps have been identified for some considerable time with traction installations, and "One-watt" lamps, which have been on the market some six months, are gaining a great amount of favour for street and shop lighting. So great has been the success which has attended these types of lamps that both "Tantalum" and "One-watt" lamps are being used for practically every type of installation. The toughness of filament for which the lamps are noted, enables them to be used in situations where the ordinary type of metal filament lamp is not successful. We reproduce here an untouched photograph showing the splendid illumination which is obtained in one of the London underground tube stations by means of a judicious combination of "Tantalum" and "One-watt" lamps. It will be noticed that a number of 100 c.p. lamps with suitable opal reflectors are fixed at regular intervals so that the light is directed upon the platform, whilst "Tantalum" lamps are installed in weatherproof brackets

on the wall centrally between them. "Tantalum" lamps have been running successfully in the trains for some years, some of the lamps having given a life of over 6,000 hours, and it will be generally agreed that lamps which give such successful results when subjected to such vibration have exceptionally strong filaments. We think that these facts should appeal to all engineers responsible for the illumination of electric trains and stations on electric railways. It is interesting to note that "Tantalum" lamps are still rapidly gaining ground for traction work, as at the present time three further tramway companies have decided in favour of installing them on their cars, whilst "One-watt" lamps are also going strong, several electric supply companies having arranged street lighting maintenance contracts with "One-watt" lamps. Full particulars concerning "Tantalum" and "One-watt" lamps can be obtained from Messrs. Siemens Brothers Dynamo Works, Limited, Tyssen-street, Dalston, London, N.E.

"Spookie" Shades.

The Simplex Conduits, Limited, have issued leaflets giving prices of novel designs in "Spookie" shades, which they are introducing for the new season. Considerable improvement in design has been effected in these new patterns, and the shades are altogether more strongly made than hitherto. By the use of a special new form of

linen paper added richness in colouring effect has been obtained. All the new "Spookie" shades supplied have the metalloid framing, which is made in three finishes:—A, brown or antique; B, green; and C, silver framing. We give two illustrations showing different designs and sizes.

The Sloan Electrical Company.

The Sloan Electrical Company, Ltd., are moving from their old address. On and after Saturday, the 19th inst. their permanent headquarters will be Conradty-house 12, Golden-lane, London, E.C.

G.P.O. AND ELECTRIC POWER.

The re-housing of the General Post Office has necessitated fresh arrangements as regards the supply of power. Formerly the supply of energy for the electric light and power purposes at St. Martin's-le-Grand and Garter-lane had been obtained from generating stations situated in the basements at the General Post Office East and Garter-lane, whilst the pneumatic services had been supplied from power pumps, with steam-driven beam-engines, situated in the basement of the General Post Office West. Now, however, the Post Office have a fine power generating station in Upper Ground-street, Southwark, just west of Blackfriars-bridge, where Mr. Herbert Samuel, Postmaster-General, and the Post Office staff, received representatives of the Press on Thursday, Nov. 10. The installation has been laid down under the supervision of Major O'Meara, engineer-in-chief to the Department. It is proposed ultimately to supply power from this station to the Parcel Post Department at Mount Pleasant. The load to be supplied immediately includes lighting, charging of telephone batteries, and small motor work in the General Post Offices North, South and West, and also power for pneumatic services, as the existing steam-driven air pumps are being replaced by electrically-driven sets. It also includes the lighting and the power for a system of lifts, conveyors, and ventilation in the new King Edward building. From the new main generating station in Upper Ground-street, near Blackfriars-bridge, passes a three-phase alternating current at a pressure of 6,600 volts, and at the sub-stations in the City this is reduced to currents suitable for the various circuits. The normal full-load capacity of the main generating plant at the power-house is 2,500 kilowatts. The boiler-house is situated on the river-front for convenience of landing coal from barges, and the steel coal bunkers in this part of the building have a storage capacity of 700 tons. The main generating sets consist of two 1,000 kilowatt turbo-alternators and one 500 kilowatt turbo-alternator. The

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extra high-tension switch-gear is contained in artificial stone cell-work arranged in a series of locked chambers, to which access is obtained at four different levels, and is operated on the electrical remote control system from a control board on the gallery overlooking the engine-room. A low-tension switchboard, situated on the ground floor underneath the gallery, is used to control the auxiliary circuits.

TELEGRAPHY AND THE ROYAL SOCIETY OF ARTS.*

The Chairman described the part played by the Royal Society of Arts in the development of telegraphy.

The first mention of telegraphs in the proceedings of the society was in 1805, when a silver medal and ten guineas were awarded to Joseph Davis for a "Night and Day Telegraph." It was not an electric telegraph, but a semaphore. Shortly afterwards a member of this society, Francis Ronalds, was experimenting in his garden at Hammersmith with an electric telegraph, and he seems to have foreseen the possibilities of the future. But it was not until 1843 that the electric telegraph came before the society, when Cooke and Wheatstone's system, as used on the Great Western Railway, was described in this room and illustrated by a complete telegraph at work.

In 1851 a Mr. George Little described an instrument in which the needles were not pivoted in the middle, but were suspended from what he called a "reservoir of magnetism."

The year 1853 saw wireless telegraphy brought before the Society. This was in a note describing the experiments of Mr. Lindsay, of Dundee, who showed how the electric telegraph could be worked through a wireless gap with water as the conducting medium.

In 1857 the Society was informed of an instrument invented by Dr. Bernstein, of Berlin, by which two messages could be telegraphed simultaneously on the same wire; and this was probably the origin of "diplex," if not of "duplex," telegraphy.

A plan for connecting the police and fire-brigade stations in London by the electric telegraph was brought before the Society in December, 1857, by Mr. (afterwards Sir Sidney) Waterlow.

In 1858 Mr. (afterwards Sir William) Siemens read an important paper on "The Progress of the Electric Telegraph" from the earliest times, and in the discussion Mr. Highton foreshadowed that system of codes which has caused not a little anxiety to submarine cable companies from time to time. He declared that he had already devised a code of his own, which contained "800,000,000 times 2,000,000 preconcerted messages," and that the messages "did not occupy one side of half a sheet of foolscap, and each would not occupy more than 12 seconds in transmission."

In 1859 a paper was read describing the printing telegraph of Professor David Hughes, and a method he had devised to cure cracks in the gutta-percha of submarine cables. This method came to nothing, but the printing telegraph conquered Europe, and still holds sway as one of the most efficient instruments in daily use.

Sir John Lamb, after referring to the well-known Cantor Lectures of Prof. Fleming Jenkin and Sir William Preece, described in detail the efforts made by the society, mainly at the instance of Mr. Edwin Chadwick, which resulted in the transfer of the telegraph service from private companies to the Post Office, and finally he showed how the institution of sixpenny telegrams in 1885 was largely due to the energetic action of the Society.

MUNICIPAL AND COUNTY CLUB.—The Right Hon. the Lord Mayor of London, Sir Vesey Strong, will be the guest of the evening, at a house dinner to be given at the Municipal and County Club on December 7 next. The Lord Chief Justice, who is President of the Club, will be in the chair.

* Abstract of the Chairman's Address by Sir John Cameron Lamb, C.B., C.M.G., at the opening meeting of the One Hundred and Fifty-Seventh Session of the Royal Society of Arts, on Wednesday, November 16, 1910.

ELECTRIC POWER COMPANY'S CAPITAL.

An extraordinary general meeting of the shareholders of Cleveland and Durham Electric Power Company, Ltd., was held under the presidency of Mr. Falconar, M.P., at which resolutions were carried reducing the capital of the company from £1,000,000 to £700,000, as agreed to at a previous meeting.

This resolution was moved by the chairman and seconded by Mr. Hobart Armstrong.

Mr. Gemmell, a shareholder, wanted to know something of the relationship of the Tyneside Electric Developments, Ltd., and the chairman, in reply, explained that they were trustees for the second debenture holders.

In further reply, he said this company naturally received full information, but it did not exercise any control. The costs of the trustees were paid by the company—that was the usual provision.

Mr. Gemmell was not satisfied with the answer. The resolution was carried with one dissentient.

At a meeting of the deferred shareholders, held under the presidency of the Hon. Mr. James, a resolution was carried binding the deferred shareholders to agreement, and the ordinary shareholders on their part, at a separate meeting, followed the same course.

In the meeting of the preferred shareholders, which followed, Mr. Gemmell took exception to the form in which his remarks were given in the official report.

A resolution confirming the foregoing arrangement was carried with one dissentient.

The chairman afterwards expressed his sense of the support the shareholders had extended to them. In explanation of the arrangements with the company's engineers he said they were paid 5% on capital expenditure, but they provided all the staff necessary for designing their work, paid their own travelling expenses, and everything else. When he and the late Sir John Milburn made these terms they thought they had driven a hard bargain with the engineers. He now found the engineers had received in all, over and above all outside expenses £14,127, and they had paid out of pocket £9,294, leaving them as their total remuneration for 4½ years £4,900. Considering they had the exclusive services of one of the partners, Mr. McLellan, and having regard to the work given, he did not think a little over £1,000 more than modest remuneration.

REVIEWS.

"Irish Railways and Their Nationalisation: A Criticism of the Report of the Vice-Regal Commission." By Edwin A. Pratt. London: P. S. King & Son. Price 6d. net.

Mr. Pratt, the well-known writer on railway economics—from the railway companies' side—has given here not only a resumé of the bulky Blue Book, but a criticism of the report. He argues that the Commission was originally designed with the idea of preparing the way for railway nationalisation, and he writes to combat such a policy. It is essentially a party pamphlet.

PATENTS.

Purification of Liquids by Electricity.

28552.—1909. H. B. HARTMAN, Pittsburg, U.S.A. The liquid to be purified is caused to flow between electrodes and there subjected to the action of an electric current which is periodically reversed. The flow of liquid and current are synchronously interrupted and the flow of current in both directions takes place in equal periods of time.

Telephone Mouthpieces.

30352.—1909. P. B. CLARKE, Liverpool. This ventilated and sound proof mouthpiece which is triangular in shape is provided with removable and renewable outer end portions. These are flexible and adapted to take over and fit that part of the face adjacent to the mouth. Antiseptic means are provided for absorbing and collecting moisture.

Dynamos and Motors.

824.—1910. CROMPTON & COMPANY, LTD., J. C. MACFARLANE, AND H. BURGE, Chelmsford. The core body of the armature is composed of core discs of two different diameters, one slightly greater than the other. By these means the radiating surface of the armature exposed to the atmosphere is increased and overheating is prevented.

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Insulating Tubes.

14459.—1910. U. P. VON PINDTERSHOFFEN, Weiner-Neustadt. The tubes are formed of coils of unsized paper of a width equal to the length of the tubes to be made. The tube is coiled on a mandrel, which is then immersed in an insulating composition until all the layers of paper are penetrated. The mandrel is first coated with a substance which renders easy the removal of the insulated tube.

Decarbonising Metallic Filaments.

2983.—1910. WESTINGHOUSE METALLFADEN-GLUHLAMPENFABRIK G.M.B.H., Vienna. This process for decarbonising metallic filaments for incandescent electric lamps consists in heating the filaments in a vacuum by means of an external source of heat until all the carbon is eliminated.

Electric Lamp.

4098.—1910. E. URBAIN & FEIGE, AND C. SCAL, Paris. In this lamp the electric current is active upon radiferous phosphorescent sulphides in an atmosphere of any rarefied gas. The sulphide is contained in a Geissler tube. The advantages claimed are, that a pure white light is given at a very slight cost.

Ventilation of Dynamo Electric Machines.

5117.—1910. SIEMENS BROS., LTD., C. KIEFFER, AND K. W. SCHAEFFER, Westminster, S.W. This machine is provided with a ventilating fan which projects from the rotor core a short distance less than the stator winding projects from the stator care. The fan has a curved rim which delivers the air in a more or less axial direction. End shields are provided shaped in such a manner that they effectually differentiate the air intake passages of the fan from the delivery passages.

Arc Lamps.

5561.—1910. T. L. CARBONE, Berlin-Charlottenberg. This lamp which burns smoke producing carbons converging downwards to the arc is provided with a closed globe consisting of a lower hemispherical chamber, which surrounds the arc, and an upper parasol-shaped chamber of metal, on the inside of which the products of combustion settle.

Armouring Insulated Cables.

6706.—1910. W. A. MARSHALL, Harrow. The spinning rollers for winding the strips of metal which surround the cable are driven by gear wheels connected with the spinning wheel and arranged to gear direct with a main gear wheel.

Long Distance Telephony.

6895.—1910. A. PETERSEN, AND G. SEM, Christiania. In this system two or more microphones are used to each of which one or more cells are connected in series. The microphones and cells are connected to the primary windings of an induction coil so that the current from the various microphone circuits is conducted in the same direction through the induction coil. The sound waves are conducted to each of the microphones by means of a tube with branches leading to each of the microphones so that sound waves emitted into the plain tube will distribute themselves to the various microphones.

Controlling the Ignition Period in Magneto Electric Ignition Apparatus.

9488.—1910. E. EISEMANN & COMPANY, G.M.B.H., Stuttgart. This centrifugal governor for controlling the ignition period of magneto electric ignition apparatus has a sleeve which works on a thread formed on the shaft through which the armature is driven. The pitch of the thread is such that the adjustment of the angular position of the armature relatively to the driven mechanism only takes place after the governor has attained a pre-determined speed of rotation.

Electric Switches.

10474.—1910. H. HIRSCH, Turin. This switch which is of the enclosed type comprises a sliding member, the movements of which operate a rotary contract member to make and break the switch contacts. The switch is suspended so that it may swing freely in all directions. The sliding member is actuated through a flexible insulating cord by a pull exerted in any direction.

Electric Motor Control Systems.

13521.—1910. GENERAL ELECTRIC COMPANY, Schenectady. This motor control system comprises a separately excited generator which has a field wound for a lower voltage than that of its source of excitation, combined with means for maintaining the field strength of the generator at a given value, such means being operative only after the motor has started.

Controlling Electric Apparatus from a Distance.

13991.—1910. E. H. WIDEGREEN, AND R. A. WIDEGREEN, Alby. This method of operating an electrical apparatus for telegraphic transmission consists in sending from the transmission station to the receiving station pulsatory electric currents having a controlled or determinable relation between the length and the intervals of the pulsations, which latter by means of a switching relay at the receiving station cause corresponding pulsations in a local circuit whereby a pulsating current is obtained in the local circuit, the effective value of which is regulated by changing the pulsations sent from the transmitting station.

Ventilation of Dynamo Electric Machines.

19164.—1910. SIEMENS BROS., AND E. O. KIEFFER, Westminster, S.W. In machines in which axial passages are made in the stator and rotor through which two currents of air are forced by fans, means are provided for keeping these two currents of air apart after they have passed the stator and rotor ducts and ejecting them at different orifices.

Manufacture of Tungsten Filaments.

3610.—1910. WESTINGHOUSE METALLFADEN-GLUHLAMPENFABRIK, G.M.B.H., Vienna. Powdered tungsten metal is added to the paste from which the filaments are prepared. The paste which is composed of tungsten dioxide, carbonaceous binding material and powdered tungsten is sprayed through dyes. The filaments obtained are heated to a temperature necessary for the reduction of the tungsten dioxide, which is about 1,000°C., and sufficient to produce strong filaments.

Charging and Discharging Electric Accumulators.

22518.—1909. A. M. TAYLOR, King's Heath. Three booster windings are arranged in combination with a series parallel grouping switch and with an increased number of cells. A bucking booster may be also provided to permit of the battery floating on the line and to assist the charge when necessary.

Electrical Indicating Means for Weighing Machines.

22539.—1909. J. DOBSON, AND H. POOLEY & SONS, LTD., Birmingham. This is an improvement in machines in which the weighing is effected by induced electrical currents produced by the movement of the weighing mechanism and indicated by an electrical indicator. The improved machine comprises an electrical motor, an alternating current generator driven by the motor and an electrical governing device interposed between the generator and the electrical means of the weighing mechanism for producing induced currents.

Electric Heating Devices for Liquids.

22592.—1909. A. E. COLEMAN, AND J. C. MCCLELLAND, London, S.W. The heater which is immersed in the liquid to be made hot comprises an inner and outer casing separated by heat insulating material. The inner chamber is provided with a number of compartments for the reception of the electric lamp or resistance wire. The liquid is caused to circulate through this chamber by convection.

Apparatus for Collecting Mechanical Energy from the Disturbed Waters of Seas and Lakes.

22725.—1909. E. BOUCHAUD-PRACEIG, Paris. This is a method of utilising the mechanical energy available in disturbed waters, and is an improvement on wave motors of the type in which a partly immersed air chamber is provided wherein the level of the water rising and falling alternately forces and draws air through the top of the chamber. In the known apparatus the air is conducted through valve controlled pipes to a motor or turbine for producing power. In the improved apparatus the air forced out or drawn into the partly immersed chamber acts directly on a wheel mounted to rotate in the top of the chamber and causes it to rotate in the same direction whether the air is forced out or drawn into the chamber.

Coding, Decoding and Checking Telegrams.

22731.—1909. J. H. SKILTON, Woodford Green. The device comprises a front plate and base plate between which is located a movable plate marked at intervals along the circumferences of concentric circles with letters and figures. The front plate has openings through which the figures on the movable plate may be seen. Check figures are arranged in connection with the code words and figures. The system of working enables two sets of figures to be cabled under one word which can be converted back and checked by the numbers and letters on the movable plate.

Indicating and Recording Apparatus for Electric Pyrometers.

22764.—1909. W. ARMOUR, Irvine, N.B. Means are provided for recording the temperature of the furnace at a number of points simultaneously by means of one recorder.

Electric Incandescent Lamp Holders.

22823.—1909. C. DAMEY, London, W. In order to prevent lamps from being fraudulently removed from public buildings and conveyances the spigot of the lamp is provided with spring pressed plungers which co-operate with orifices in the holders and render removal somewhat difficult.

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PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

The Electrical Lighting of Gas Jets.

The H. Tuchman Manufacturing Company, Dyer's-buildings, Holborn, London, have recently brought out an improved system of lighting gas lamps from a distance.

Briefly, the system consists of an ordinary motor car trembler coil worked from two small dry cells, from which wires are run, through bell pushes, to the very small coils, one of which is placed on each lamp. The action is quite simple; on pressing the push in the circuit of the gas jet it is desired to light (and, of course, turning on the gas tap), the trembler sends current along the wire to the little induction coil on the lamp, and induces in its high tension winding sufficient voltage to spark across the spark gap arranged just above the jet.

A special switch has been designed to do the switching on and off of lights and the turning of the tap in one operation.

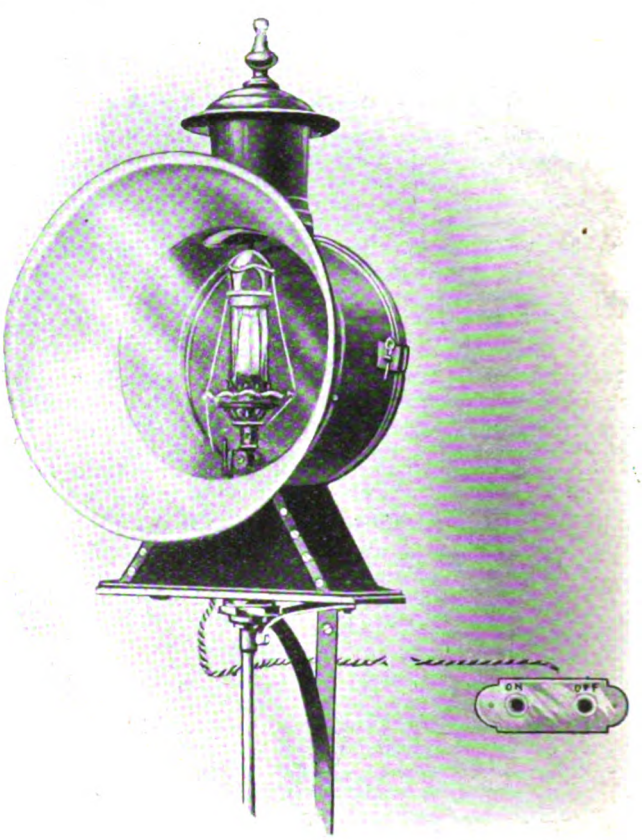
The pushes employed are a considerable improvement on the ordinary electric bell push, and are much better looking, while no more expensive in price. They are, in fact, being largely sold for bell work.

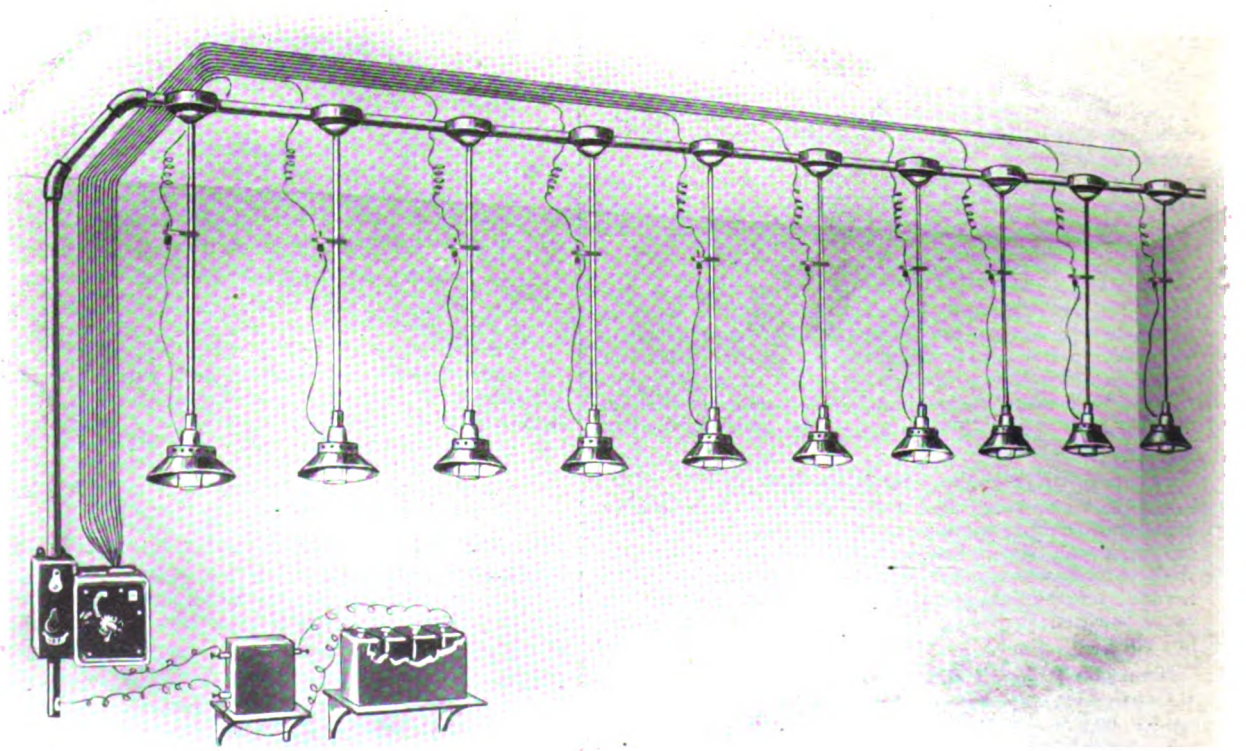
The little induction coils are only about 1 inch long and ½ inch diameter, and are enclosed in steatite boxes to protect them from the heat.

As the current up to each induction coil (situated at the gas jet) is only at about 2 volts ordinary bell wiring is employed. This is a great advance over other systems in which a high tension distribution is used.

The accompanying illustrations explain themselves.

This system, which is very cheaply applied, should provide some good work for electrical contractors among those who are not yet prepared to make the full step to electric lighting; it affords them an opportunity of encroaching on the plumber's domain as he encroached on their's.





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Some of the superheaters in use are the Schmidt, Swindon, Cole, Vaughan-Horsey, Watkin, Baldwin, Pielock and Clench. The New Century Company's system using heated air and steam is interesting.

Modifications have been made in the cylinders, packings, valves and lubrication, although opinions are divided as to the necessity for forced lubrication and even piston valves. Even if piston valves are not essential, they are undoubtedly desirable. As far as lubrication is concerned, so long as the oil is delivered between the surfaces to be lubricated it matters little whether a displacement lubricator or a pump distributes it. Many points requiring consideration arise in the theory of superheating, especially when the combination with compounding is considered.

* Abstract of a paper read before Northampton Institute Engineers Society, Nov. 18, 1910.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "THE EDITOR, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

THE ELECTRIC VEHICLES.

DEAR SIR,—It seems to me that the only way to familiarise the public with the advantages of electric vehicles is for the central stations to use them themselves.

We, here, are at just about the limit with our present carrying arrangements for meters, cables, ovens, radiators, motors, stores, and so on, and I am proposing shortly to put before my Committee a three-cornered scheme between the makers of the vehicles, battery people, and ourselves, by which we hire from the vehicle makers light run-abouts similar to Selfridge's and Bourne and Hollingsworth's delivery vans.

These will have on them, very distinctly marked, that they are electric vehicles, and the name plate will be so arranged that we can lend the vehicles to large firms in our district for them to prove for themselves the value of them and the low cost of operation.

If each of the three in the scheme is prepared to give something away in order to try and push the business, I believe we shall succeed; at any rate, no electric supply undertaking ought to use anything but electric vehicles for their own carriage.

Yours faithfully,
A. HUGH SEABROOK.
General Manager.

Borough of St. Marylebone Electric Supply,
19 and 20, York-place, Baker-street, W.
November 19, 1910.

THE ELECTRICAL COMMITTEE.

The Committee for the Protection of Electrical Interests have decided to hold a general meeting to discuss the advisability of undertakers under the Electric Lighting Acts being empowered to wire premises and supply apparatus for the consumption of electrical energy, on loan, or otherwise, on Wednesday, December 7, at 8 p.m. This meeting will be open to all members of the electrical industry, and those who would like to take part are invited to send in their names to the hon. secretary, Mr. R. Borlase Matthews, Bank Buildings, Kingsway, W.C. By courtesy of the Council, the meeting will be held in the lecture theatre of the Institution of Electrical Engineers, Victoria Embankment, E.C. In the unavoidable absence of the President of the Committee—the Hon. Arthur Stanley, M.P.—due to the forthcoming parliamentary elections, the chair will be taken by the Vice-President, Mr. Robert Hammond, M.Inst.C.E., M.I.E.E., M.I.Mech.E. Arrangements have been made for those who would like to dine together before the meeting to do so at Gatti's Restaurant in the Strand. The price of the dinner is 3s. 6d., but no tickets will be issued. It would, however, be a convenience if those who purpose dining would let the hon. secretary know of their intention to do so. As the dinner is, of course, informal, ordinary dress will be worn.

THE ELECTRICAL ENGINEERS (TERRITORIALS), LONDON DIVISION.—Orders for week ending December 3, 1910:—Officer commanding, Lieut.-Col. H. M. Leaf. Monday, November 28, "A" Co., Technical Drill, 7 to 10 p.m. Tuesday, November 29, "B" Co., Technical Drill, 7 to 10 p.m. Thursday, December 1, "C" Co., Technical Drill, 7 to 10 p.m. Friday, December 2, "D" Co., Technical Drill, 7 to 10 p.m. (Signed) P. H. Campbell, Capt. R.E., Adjutant.

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BRICK TOWER TERMINALS FOR OVERHEAD LINES.

By "Wigwam."

The rapid extension within recent years of overhead electric transmissions of high potentials has brought in its train a considerable amount of experimental engineering, one of the main objects of which has been to avoid heavy capital outlay so far as possible until the fundamental points of design have been thoroughly tested under practical working conditions. This applies very forcibly to pole line equipments, constituting, as they do, such a large proportion of the capital cost of the modern bulk supply system over large areas. Structures, almost temporary in their character, have been utilised to support the overhead wires, and it is only by process of experiment that more permanent designs have been evolved. This applies more particularly to the terminals for overhead lines.

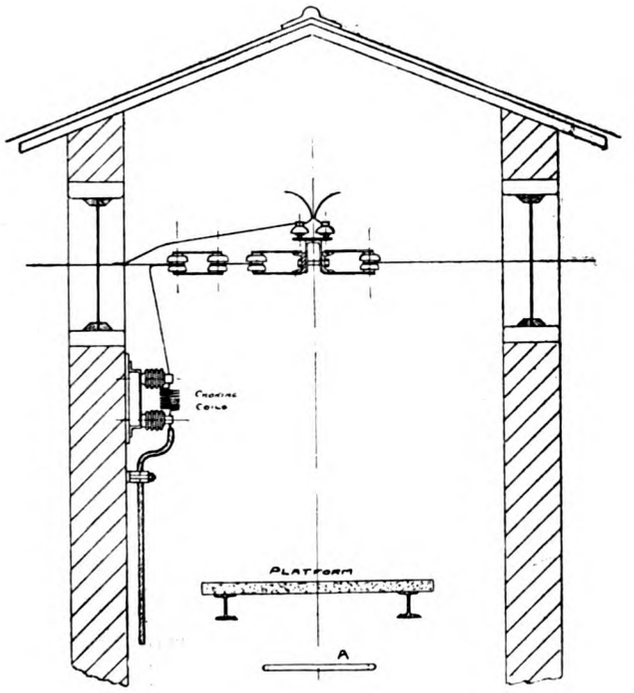

FIG. 1.

Until comparatively recently it has been the almost invariable practice to erect a number of wooden poles, similar to those used for the intermediate supports of the transmission line, braced together and stayed, to form the terminals of the lines and to vary the number and size of the poles according to the weight to be carried. Probably this practice is the natural outcome of following the lead given by telegraph and telephone engineers in overhead constructional work, and, while light lines and low tensions were the rule, it no doubt satisfactorily met the case. With the more general use of high and extra-high tensions and the increasing size of power transmission schemes, however, the advantages of finishing the lines inside the building became more apparent. The necessity also of providing some suitable discharge apparatus and of fixing it in the most effective position has also tended towards the use of towers rather than poles.

One frequently sees evidence of carelessness or absence of thought in the manner in which lightning arrestors and their accessories are fixed; horn and similar type arresters are exposed to the weather in such a way that during snowstorms they become short-circuited, and, if the current is off at the time, buried in frozen snow; choking coils are sometimes fixed in the earth circuit instead of in the leads, and the general arrangement is frequently such that the arresters are practically useless. With a properly designed tower, laid out with an eye to the proper placing of the protective apparatus, as well as to the finishing off of the lines, such defects are less excusable and are also more apparent at sight.

In Fig. 1, showing a vertical section of a typical brick terminal tower, the apparatus is protected from the weather and at the same time is readily accessible. The arrangement is such as to give a practically straight lead to the arresters, and these are free to discharge without risk of fire. Horn type arresters are shown, but the same position would be equally suitable for other types according to the tension and general conditions.

Moreover, the base of the tower may be used for a transformer room and the tower itself then becomes a natural ventilating shaft, the warm air from the transformer tending to keep the tower dry; in this case, however, provision must be made for the hot air to get away through suitable ventilators.

In Fig. 1 a plate glass system of weather protection is shown, and Fig. 2 illustrates the method of dividing the glass so that it can be fixed after the wires are erected in position. The holes through which the wires pass should give ample clearance and the minimum diameter is about $1\frac{1}{2}$ inches.

This glass protection is to prevent snow and hail drifting in and also to exclude birds. These latter soon find their way into an unprotected tower during bad weather, and, being electrocuted, short-circuit the lines and trip the circuit breakers. As this generally happens about dusk it has been the frequent cause of long and anxious searching for faults in the apparatus before the real cause has been discovered.

The tower should also be fitted with a lightning conductor, and the earth wire must be so arranged that it can also be used for the arresters and give from each an easy and straight path to earth.

For extra high tensions, where a resistance must be connected between each of the arrestors and earth, it is possible that the resistances may, on account of their size and weight, be inconvenient in the tower itself, and, in this case, separate and distinct earth wires will be required for the lightning conductors and arresters. The lightning conductor may, however, be used for earthing the whole ironwork in the tower.

It is also an advantage to have a small platform at a height convenient for a man to work on the fittings during erection, and from which he may also clean or adjust them afterwards; and this platform is especially useful in the case of additional wires being required. The platform may be made accessible by a series of iron rings, A, cemented into the wall, and it may also be provided with an insulating mat if thought desirable. The roof, above the arresters, should be either of non-inflammable material or should be protected with a sheet of non-inflammable material, say, asbestos millboard, so that the arresters may discharge without risk.

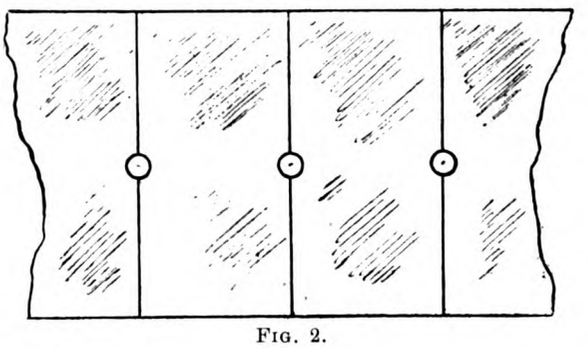

FIG. 2.

A tower as described above makes a neat and convenient terminal for a transmission line and has numerous advantages over a pole erection, amongst them being that (1) the apparatus is protected from the weather and gives better insulation tests; (2) the whole of the leads are in a separate fireproof department, easily accessible; (3) a man may work in such a tower with greater safety than on poles or ladders; (4) the tower may be used for both high and low tension leads, the former being taken up one side, and the latter on the opposite side; and (5) it may also be used as a natural ventilating shaft as already described.

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The cost of such an arrangement, particularly where a number of lines are required, is not much greater than that of a pole erection, since the height is only that of the poles themselves, and the space required is also no greater, as, with the tower, no stays are necessary. It is therefore evident that the tower construction is in theory and reason a better arrangement than the pole structure, although at first sight it appears unduly expensive. In practice the good points advanced above are amply in evidence, and it is to be hoped that "the" power undertakings will see the value of the more permanent form of construction for terminal towers.

ELECTRIC RAILWAY COST ESTIMATING.*

By H. M. Hobart, M.Inst.C.E.

With steam-locomotive traction, there must be carried on the train the steam generating and consuming apparatus, comprising a boiler and an engine. For hauling long trains stopping only at rare intervals, the weight of the locomotive together with that of the fuel and water, need not constitute a large percentage of the weight of the train, for in the first place there is in such cases no necessity for high acceleration and the corresponding high tractive force per ton, since with but few stops, the schedule speed will be inappreciably affected by the acceleration employed; and in the second place, the tractive force per ton required to overcome friction at constant speed is not great at the highest speeds practicable with the present-day standard of permanent way construction†. The tractive force required to accelerate a 500-ton train at a quarter of a mile per hour per second, is, including friction, only some 6 tons, and this will bring the train up to a speed of 60 miles per hour in four minutes. The greater acceleration practicable with electric haulage would, in such a case, only save two or three minutes, and this would be of no consequence in a long run from start to stop. The tractive force required to haul a 500-ton train *at a constant speed* of 60 miles per hour is only a matter of about 3 tons, corresponding to about 1,100 horse-power output from the locomotive. Such conditions are well within the capacity of the steam locomotive, and there is no object in employing electrical methods for such work, except for special cases, such as for long or frequent tunnels, where smoke and steam are great obstacles, or for heavy grades. Thus a grade of one-half of one per cent. would, for a speed of 60 miles per hour, nearly double the output required of a locomotive hauling a 500-ton train.

But such conditions are exceptional, and the complete electrification of an extensive main-line railway would rarely be justified unless it were desired to introduce much higher speeds throughout the system, and this would involve complete reconstruction of the permanent way. In such a reconstruction special stress would be laid on the elimination of curves so far as practicable, but grades would be by no means so objectionable with electric traction as they are with steam-locomotive traction, since with electric traction the train commands the power of a large central station, and high temporary loads are readily managed. It is in greater degree the limitations imposed by present-day permanent way construction than any limitations in the steam locomotive which restrict the speed on long runs. Incidentally it is interesting to observe that since grades are relatively unobjectionable in electric traction, the enormous outlay for tunnels could in some instances be avoided.

Notwithstanding a number of obvious advantages which would attend the complete electrification of an extensive main-line railway, the capital outlay would run to a formidable amount, and for the speeds at present customary the advantages obtained would be altogether incommensurate.

Is there, then, any economic field for large applications of electric traction on main line railways? This question may be answered most emphatically in the affirmative. In the case of most of the British main-line railways, although the systems often extend for a few hundred miles from the great cities, a very large percentage of the passenger train mileage is within some 25 miles of the chief terminii, and its object is to supply the needs of an urban and suburban passenger traffic. The percentage in question cannot be ascertained from any published Board of Trade returns, and it would be a very arduous task to work it out from Bradshaw, but a little common-sense reflection will satisfy any of you that this is the case.

What is the character of this urban and suburban traffic? On roads where it is still provided by trains hauled by steam locomotives, such a service is characterised by vexatiously infrequent trains. Satisfactorily high schedule speeds are only obtained by arranging the time table for infrequent stops. When the stops are at all frequent, the schedule speed is so low that the tramcar and motor 'bus provide satisfactory alternatives.

These unsatisfactory conditions are the direct consequence of the limitations of the steam locomotive. A 50-ton locomotive, hauling behind it a 50-ton train, and exerting a draw-bar-pull of 3 tons, will provide an acceleration of one mile per hour per second. But this is obviously too expensive a combination. The locomotive constitutes half the weight of the train. If this same locomotive is required to haul a 200-ton train, and if, at starting, it exerts the same draw-bar-pull of 3 tons, the acceleration will be less than two-tenths of a mile per hour per second. In this 200-ton train, the locomotive constitutes only 20 per cent. of the total weight of the train.

But a train provided with an electrical equipment constituting only 20 per cent. of the total train weight‡, is prodigally proportioned for providing an acceleration of 1 mile per hour per second and with frequent stops, and it will have ample capacity to perform such a service continuously for the entire working day of, say, 18 hours. Such a train, on a 16-mile-per-hour 2-stop-per-mile service can be relied upon to aggregate 50,000 miles per annum, whereas a steam locomotive rarely aggregates half this distance per annum.

The superiority of electric trains for urban and suburban service emanates primarily from their great capacity for high acceleration§. Instead of being dependent upon a power plant small enough to be carried on the train, the electric train derives its power from a large generating station, and merely carries apparatus for transforming from electricity into work the energy extracted from the coal at the distant generating station and transmitted as electricity to the train.

Those who have not personally dealt extensively with the interesting calculations involved in electric traction work at first find difficulty in comprehending why capacity for high acceleration should have such sweeping consequences as to involve the fundamental appropriateness of a method of traction‖. To throw light on this point I cannot do better than to direct your attention to the curves in Fig. 1. Let us especially examine the curve corresponding to runs of only half a mile from start to stop. The curve shows us that a steam train with an acceleration of, say, 0·4 miles per hour per second can only maintain a schedule speed of some 11 to 12 miles per hour, whereas an electric train with an acceleration of 1 mile per hour per second can provide a schedule speed of some 18 miles per hour. If the distance between stops is 1 mile instead of half a mile, we see that the schedule speed for the steam train will only be of the order of 17 miles per hour, while the electric train can provide a schedule speed of about 25 miles per hour. These curves are derived by simple graphical constructions which are dependent upon the immutable laws of space and time, and the results are incontrovertible. I have stated, and I believe that you will agree with me that it is obvious, that for long-distance runs without intermediate stops, capacity for high acceleration is of absolutely insignificant importance. No less obvious is the converse proposition

* Paper read on October 28, 1910, at the Arc Works Engineering Society, Arc Works, Chelmsford.

† See p. 117 of author's "Electric Trains" (Harper & Bros., 1910).

‡ See p. 194 of author's "Electric Trains" (Harper & Bros., 1910).

§ See Prof. W. E. Dalby's Presidential Address before the Engineering Section of the British Association, in September, 1910. The address is published in extended abstract on p. 279 of the ELECTRICAL ENGINEER for September 9, 1910.

‖ See a paper entitled "Electric Traction on City and Suburban Railways," by H. M. Hobart. This paper was read at the School of Military Engineering, Chatham, on October 14, 1909, and was published in full in the "Tramway and Railway World" for March 3 and 10, 1910. It has also been published as a separate pamphlet by the "Tramway and Railway World."

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that capacity for providing high speeds with a frequent-stop service is inseparably dependent upon capacity for providing high acceleration.

The development of steam railways to their present high stage of efficiency has entailed an enormous capital outlay, and this constitutes the chief stumbling-block in the way of the electrification of urban and suburban sections. The capital already expended has been directed towards obtaining the best results with steam-locomotive methods, and the modifications essential to electrical operation involve further large outlays. Carter, in a paper entitled "Electrification of Suburban Railways," read at the recent summer meeting of the Institution of Mechanical Engineers*, states that, taking interest at 4 per cent., the capital burden in various cases of electrification of sections of British railways works out as follows:—

Tynemouth section of the North-Eastern Railway = ... 1·9d. per train mile.
Southport section of the Lancashire and Yorkshire Railway = .. 2·0d. per train mile.
Mersey Railway = ... 4·3d. per train mile.
Victoria-London Bridge section of the L.B. and S.C. Railway = 6·4d. per train mile.

The above values correspond to the data of Carter's paper. Extensions and increased train-mileage per mile of electrified line, obviously gradually decrease the capital burden per train mile. With the increased train service introduced on the L.B. and S.C. Railway on the first of the present month the capital burden is reduced from the above figure of 6·4d. to about 5·5d. per train mile, and the consummation of the programme now contemplated for this section of railway will, in the improbable event that the present amount of rolling stock will suffice for the intended future service†, reduce the capital burden to 4·1d. per train mile. The result for the first two railways indicates that *by the appropriate use of an appropriate system*, the capital burden incurred in electrifying suitable suburban sections of main-line railways need not exceed 2d. per train mile, but it is impossible to make any definite statement, as the figure is a function of the frequency of trains, the frequency of stops and the schedule speed and also of various circumstances peculiar to each undertaking.

The case for electrification of urban and suburban lines is by no means so overwhelmingly convincing from the railways' standpoint, that engineers can afford to disregard a difference of a few pence in the train-mile costs incurred by alternative electrical methods or systems. The strong point of electrification is that, in respect to obtaining high speeds and frequent stops, the results cannot be approached by steam-locomotive methods, and these attractive features ultimately produce an increase in traffic which, notwithstanding the large capital outlay and the by-no-means-low operating costs, yields a larger profit in virtue of a greatly increased turnover. The costs of an electric service may, and usually will, be higher than the cost of the superseded steam service, and obviously the profit will only be greater when the receipts increase in a greater ratio than the cost. It will not be necessary to pursue this line of thought further in order to understand that railway-electrification propositions should only be embarked upon after a most scrupulously detailed examination into the relative merits of the available methods and systems. Such an occasion as the reading of a brief paper does not afford opportunity for a detailed study. I believe, however, that you may be interested in following through with me the application to a hypothetical case, of a sort of outline programme for a rough preliminary comparison.

A portion of the data which I shall set forth has, on former occasions, been employed by me in establishing certain comparisons, but on these previous occasions I have been so rash as to take actual instead of hypothetical cases as the subject of my comparison‡. This course, while it has aroused a considerable amount of unfavourable comment, has, nevertheless, had the advantage that data which would otherwise have been withheld from publication has been disclosed by my critics, and I now find myself in a stronger position in that my figures can now be based on still-more-fully-authenticated premises than in the original instances.

A service of electrically-propelled trains operated to a schedule speed of 25 miles per hour with one stop per mile, while it is distinctly different from any service at present working in this country, nevertheless happens to be intermediate between two well-known cases, that of the Southport section of the Lancashire and Yorkshire Railway and that of the Victoria-London Bridge section of the L.B. and S.C. Railway. These two services and my hypothetical service may be contrasted in the following table:—

		Schedule speed.	Distance between stops.	Coaches per train.	Length of train.
I.	L. and Y. Railway ..	30 ..	1·32 ..	3 ..	180
II.	Author's hypothetical case	25 ..	1·00 ..	3 ..	180
III.	L.B. and S.C. Railway ..	22 ..	0·87 ..	3 ..	180

Thus the service I have conceived for my hypothetica railway is indisputably a typical one, and I propose to work out the train-mile costs for its operation by two different electrical systems. In the one system the electricity is generated in the three-phase form, and is transmitted at high pressure to sub-stations in which it is converted, in rotating machinery, into continuous electricity at a pressure of, say, 600 volts. At this pressure it is supplied to the trains by means of bonded contact-rails suitably supplemented by feeders. In the other system the electricity is generated in the single-phase form, is transmitted at high pressure to distributing cabins, whence, without transformation of pressure or kind, it is distributed to the trains by means of *overhead* contact lines.

I propose to take the case of 10 miles of double track over which it is desired on week-days to operate a 12-minute service* of 3-coach trains from 6 a.m. until midnight, and to run half this service on Sundays. The service is maintained for 18 hours per day. Five trains (on the average), are despatched in each direction per hour or (5 × 18 =) 90 trains in each direction on week days and 45 trains in each direction on Sundays. This aggregates

(313 × 90 × 2 × 10) + (52 × 45 × 2 × 10 =) 610,000

train miles per annum. As already stated, the schedule speed is 25 miles per hour and there is one 20-second stop per mile. For such a schedule, good practice requires that at least 11 trains shall be provided. Consequently each train will be required to run $\left(\frac{610{,}000}{11} =\right)$ 55,500 productive miles per annum.

The 3-coach trains are 180 feet in length, and provide 180 seats. The coach bodies weigh 18 tons each or (3 × 18 =) 54 tons for the three coach-bodies in a train. The trucks weigh some 6 tons each, or (6 × 6 =) 36 tons per train. Thus, *exclusive* of the electrical equipment, the weight of each train is (54 + 36 =) 90 tons. For a schedule speed of 25 miles per hour, and with one 20-second stop per mile, the consumption of electricity on test runs will be about 90 watt hours per ton mile. Consequently electricity is, during test runs, consumed at the rate of

$$\left(\frac{90 \times 25}{1{,}000} =\right) 2{\cdot}25 \text{ kw. per ton weight of train.}$$

The efficiency of the electrical equipment will be about 70 per cent.† Thus the average output from the motors will be

$$\left(\frac{2{\cdot}25 \times 0{\cdot}70}{0{\cdot}746} =\right) 2{\cdot}11 \text{ h.p. per ton weight of train.}$$

Up to this point there has been no need to distinguish between systems. Continuous-electricity equipment yields an average output of about 10 h.p. per ton weight of equipment, while single-phase equipment yields an average output of 5·5 h.p. per ton weight of equipment‡.

* See Proc. Inst. Mech. Engineers, 1910, Part III.

† The service which it is asserted (see article in the "Light Railway and Tramway Journal," Vol. 22, p. 17) will ultimately be run with the 16 motor cars and 8 trailers at present constituting the rolling stock of this line, would amount to 73,000 miles per train per annum. This is a result as yet unattained on any electric railway.

‡ See the author's paper entitled "The Cost of Electrically Propelled Suburban Trains," read at the recent summer meeting (July 29, 1910) of the Institution of Mechanical Engineers (Proc. Inst. Mech. Engineers, 1910, Part III.).

* Of course the 12-minute service is the *average* for the day, and is increased to, say, a 6-minute service during rush hours, and reduced to an 18-minute service during times of lightest traffic.

† See Chapter V. of author's "Electric Trains" (Harper & Bros., 1910).

‡ While this great disparity in weights was denied when I first drew attention to it several years ago, it is now admitted by all electrical engineers who are well-informed in the matter.

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Consequently, according as we use continuous electricity equipment or single-phase equipment, the weight of the equipment per ton weight of train will be either

$\left(\frac{2{\cdot}11}{10} =\right)$ 0·211 ton per ton weight of train, or

$\left(\frac{2{\cdot}11}{0{\cdot}55} =\right)$ 0·384 ton per ton weight of train.

Denoting by w the total weight of the train, and remembering that the coach bodies and trucks weigh 90 tons, then we have

For the continuous-electricity train $w = 90 + 0{\cdot}211\ w$.

$\therefore\ w = 114$ tons.

For the single-phase train $w = 90 + 0{\cdot}384\ w$.

$\therefore\ w = 146$ tons.

The electrical equipments in the two cases weigh :—

For continuous electricity : (114—90 =) 24 tons.

For single-phase electricity : (146—90 =) 56 tons.

The costs of the trains may be estimated on the basis of

£80 per ton for coach bodies.

£22 per ton for trucks.

£125 per ton for electrical equipment.

The weights and costs of the two trains are shown in the following table :—

	Cost per Ton.	Continuous-electricity train.		Single-phase train.	
		Weight.	Cost.	Weight.	Cost.
Coach bodies	£80	54 tons	£4,320	54 tons	£4,320
Trucks..	£22	36 tons	£790	36 tons	£790
Electrical equipment	£125	24 tons	£3,000	56 tons	£7,000
Total weight	—	114 tons	—	146 tons	—
Cost of assembling and all further costs (at £5 per ton of total weight of train) ..	—	—	£570	—	£730
Total cost of train	—	—	£8,680	—	£12,840
Cost of train per ton of total weight	—	—	£76·0	—	£88·0
Cost of train per seat (or per foot)	—	—	£48·1	—	£71·4

The outlay for rolling stock is

For continuous electricity (11 × £8,680 =) £95,500.

For single-phase electricity (11 × £12,840 =) £141,000.

The cost of the contact conductors (3rd rail or overhead wire) will depend greatly on the location of the line. Let us for both systems take £2,000 per mile of single track* as covering all capital outlays for contact conductors, bonding, feeders, etc., from the trains to the sub-stations. This item thus amounts to (20 × 2,000 =) £40,000.

The load factor of the sub-station output may be taken as 20 per cent. for a 12-minute service for 18 hours per day and 10 miles of route. Before we can estimate the cost of the sub-station we must estimate the load. Taking the input in actual service as 30 per cent. greater than on test runs, then the input at the train per annum will be :—

For continuous electricity equipments

$\left(\frac{610{,}000 \times 114 \times 90 \times 1{\cdot}30}{1{,}000} =\right)$ 8,150,000 kw. hour,

and for single-phase equipments :—

$\left(\frac{146}{114} \times 8{,}150{,}000 =\right)$ 10,420,000 kw. hour.

The maximum load on the sub-station will be (allowing 98 per cent. efficiency from sub-station to trains) :—

For continuous electricity

$\left(\frac{8{,}150{,}000}{0{\cdot}98 \times 0{\cdot}20 \times 8{,}760} =\right)$ 4,750 k.w.

and for single-phase

$\left(\frac{10{,}420{,}000}{0{\cdot}98 \times 0{\cdot}20 \times 8{,}760} =\right)$ 6,080 k.w.

For the continuous electricity system let us provide two sub-stations, each for a peak load of $\left(\frac{4{,}750}{2} =\right)$ 2,375 kw.

A rated capacity of 3,000 kw. of machinery in each sub-station (with a guaranteed capacity of, say, 5,000 kw. for intermittent overloads), will consist with good practice. These two sub-stations will cost some £30,000 (*i.e.* £15,000 each). The distributing cabins which, in the single-phase system, replace the sub-stations, will cost about one-fourth* as much per million kw. hours per annum as the sub-stations in the continuous-electricity system. On this basis, the capital outlay for the distributing cabins for the single-phase system amounts to :—

$\left(\frac{10{\cdot}42}{8{\cdot}15} \times 30{,}000 \times 0{\cdot}25 =\right)$ £9,600.

I shall take the case where the electricity is purchased from a Supply Company which shall deliver it to the railway's sub-stations. For the continuous-electricity system the railway will receive the electricity at the sub-stations in the three-phase form and at unity power factor. For the single-phase system the electricity will be received at the distributing cabins in the single-phase form and at an average power factor of 0·80. The single-phase electricity will cost the most for several reasons :—

1st. Because of the greater cost and less efficiency of single-phase generators as compared with three-phase generators.

2nd. Because of the low power factor of the load on the generating set. For a given closeness of pressure regulation, a single-phase generator delivering a given kilowatts load at 0·8 power factor will be a very much larger machine than a three-phase generator delivering the same kilowatts load at unity power factor.

3rd. Because of the greater cost of the transmission line. (The conductors must be larger for a given kilowatts load owing to the low power factor)†.

The price of the electricity will vary according to many circumstances, such as the cost of coal and water, the distance of transmission and other causes. It is only the *relative* prices which will materially affect the results of this comparison. We may fairly take these, for the electricity as delivered to the sub-stations, as 0·62d. for the continuous-electricity system and 0·68d. for the single-phase system. The efficiency of the single-phase sub-stations will be 100%, as these will be merely distributing cabins. The efficiency of the continuous-electricity sub-stations will be 89%.‡ Consequently the amount of electricity to be paid for annually will, for the continuous-electricity system, be :—

$\left(\frac{8{,}150{,}000}{0{\cdot}98 \times 0{\cdot}89} =\right)$ 9,350,000 kw. hour,

and for the single-phase system :—

$\left(\frac{10{,}420{,}000}{0{\cdot}98} =\right)$ 10,650,000 kw. hour.

At the above prices, the annual outlay for electricity is—

For the continuous electricity system :—

$\left(\frac{9{,}350{,}000 \times 0{\cdot}63}{240} =\right)$ £24,500

* Up to the present time the capital outlays for all structures, machinery and work between the sub-stations and the trains, necessitated for electrical working, has, when the work has been of the high-grade character which would be required for urban and suburban sections of main-line railway in this country, been far higher with the single-phase than with the continuous system, and often the difference in favour of the latter system has been exceedingly great. Thus on p. 915 of the "Street Railway Journal" for May 25, 1907, Mr. Wilgus, Vice-President of the New York Central Railway, states :—"Much has been said also about the cost of overhead single-phase construction on the New York New Haven and Hartford Railway. In 1906, one authority estimated it at £3,200 per mile, but the actual cost has been £10,000 per mile." Unless it be accounted for by a very high outlay per mile for overhead construction for track return boosters, for feeders and for distributing cabins and their equipment, it is hard to understand how the electrification of the 8·7-mile line between Victoria and London-bridge (on the L.B. and S.C. Railway) could have required the admitted capital outlay of £250,000. Had the continuous-electricity system been employed, the total capital cost of electrification would not have exceeded £160,000, and the operating costs would also have been less than with the single-phase system. (See also the author's contributions to the "Times" Engineering Supplement during April and May, 1907).

* This 4 : 1 ratio of costs is put forward by Mr. C. F. Scott, of the Westinghouse Company, in Part III. of the Proceedings of the Institution of Mechanical Engineers for 1910. As is well known, Mr. Scott is one of the leading advocates of the single-phase system of railway electrification, and this lends weight to the view that the cost of the distributing cabins is not over-estimated.

† I have no doubt that these further disabilities of the single-phase system will be denied as persistently as were, in the first instance, my statements as regards the disabilities of single-phase train equipment. But, just as in this latter case, it will ultimately be recognised that I have made a conservative statement of these further points of inferiority of the single-phase system for urban and suburban railway electrification.

‡ Mr. Aspinall, on p. 454 of the 1909 "Proceedings of the Institution of Mechanical Engineers," shows that for 57,190 kw. hours delivered from the sub-stations of the Southport Railway, on a certain day, there was a loss of 3,480 kw. hours in the rotary converters, and a loss of 1,885 kw. hours in the transformers. Consequently, for the service on that road on the day in question (July, 1906) the overall efficiency of the sub-stations was

$$\frac{57190}{57190 + 3480 + 1885} = 91 \text{ per cent.}$$

I may say that in taking 89 per cent. for the sub-station efficiency, I am reasonably conservative.

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and for the single-phase system :—

$$\left(\frac{10{,}650{,}000 \times 0{\cdot}68}{240} =\right) £30{,}200$$

Per train mile, these two values reduce to :—

$$\left(\frac{24{,}500 \times 240}{610{,}000} =\right) 9{\cdot}7\text{d. for continuous-electricity trains,}$$

and

$$\left(\frac{30{,}200 \times 240}{610{,}000} =\right) 11{\cdot}9\text{d. for single-phase trains}$$

The annual outlay for repairs and renewals works out as follows :—

For rolling stock I shall take 8% for both systems.

For the sub-stations in the continuous-electricity system : 6%.

For the distributing cabins in the single-phase system : 4%.

Coming to the repairs and renewals of the contact-conductors, insulators, bonding, feeders, etc., it should be noted that renewals of contact rails can be effected by day gangs, like ordinary platelayers' work, but renewals of overhead conductors, in cases where traffic is frequent, are almost necessarily carried out during night time and on Sundays, and by specially trained gangs. In view of these circumstances, and of the inherently less simple and less robust constructions employed for the overhead system, it is distinctly favouring the single-phase system to assign a 50% higher figure to repairs and renewals for the single-phase system. For the two systems I shall take for the repairs and renewals of the contact-conductors, insulators, bonding, feeders, etc. :—

Continuous-electricity system	5·0%
Single-phase system	7·5%

The annual cost for repairs and renewals thus works out as set forth in the following table :—

		Per cent.	Continuous-elec. System.	Single-phase System.
I.	Rolling stock	8·0 ..	£7,640 ..	£11,300
II.	Sub-stations	6·0 ..	£1,800 ..	—
	Distributing cabins ..	4·0 ..	— ..	£380
III.	Contact cond. insulators, feeders, bonding, etc. :—			
	(*a*) cont-elec. system ..	5·0 ..	£2,000 ..	—
	(*b*) single-ph. system ..	7·5 ..	— ..	£3,000
	I. + II. + III.	— ..	£11,440 ..	£14,680
	Do. per train mile	.. ..	4·5d. ..	5·8d.

For wages of drivers and of sub-station attendants the following figures are appropriate :—

		Cont. elec.	Single-phase.
IV.	Drivers' wages per train mile	1·0 ..	1·0
V.	Sub-station attendants, inspectors, etc. ..	0·8 ..	0·4
	IV. + V.	1·8 ..	1·4

Summing up these items we have :—

		Cont. elec.	Single-phase.
A.	Outlay for electricity—per train mile..	9·7d. ..	11·9d.
B.	Repairs and renewals :—		
	I. of rolling stock		
	II. of sub-stations per train mile	4·5d. ..	5·8d.
	III. of contact cond., etc.		
C.	Wages of drivers and of sub-station attendants per train mile	1·8d. ..	1·4d.
	A + B + C	16·0d. ..	19·1d.

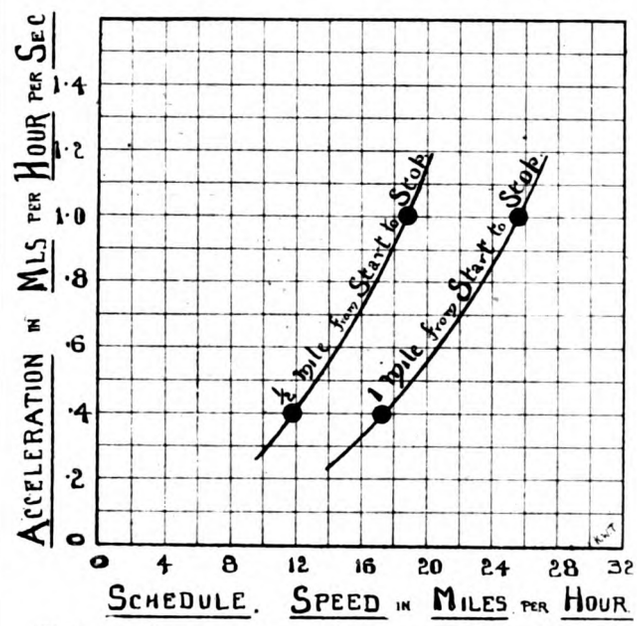
The capital outlays in these two cases are as follows :—

	£	£
Rolling stock	95,500 ..	141,000
Sub-stations or distributing cabins	30,000 ..	9,600
Contact conductors, etc	40,000 ..	40,000
Tools, buildings, and all further capital outlays incurred	10,000 ..	10,000
Total capital outlay	£175,500 ..	£200,600
Interest on above at 4%	£7,030 ..	£8,050
M. Do. per train mile	2·76d ..	3·16d.
A + B + C (of preceding table)	16·0d. ..	19·1d.
M + A + B + C	18·8d. ..	22·3d.

Amount by which the train-mile cost of the single-phase system exceeds that of the cont. elec. system .. .. 22·3d. − 18·8d. = 3·5d.

The above amounts (22·3d. and 18·8d. per train mile) only constitute a portion of the total train-mile costs, but the remaining costs will be practically independent of the electrical system adopted. It is well known that for various sorts of urban and suburban railways (underground, tube, and main line) the receipts per seat mile range from 0·16d. to 0·20d., and that the latter figure, though occasionally closely approached, is rarely or never reached. For the 3-coach 180-seat train under consideration, the receipts per train mile are thus very unlikely to exceed (0·20 × 180) = 36d., and they are liable to fall considerably short of this amount. When, in the railway returns, we find, for passenger trains, receipts ranging up to 66d. per train mile (South-Eastern Railway for 1909) we must remember that these results correspond to trains composed of many coaches. Even for these long, steam-hauled trains, the receipts per train-mile (for passenger trains) in the six best cases, were, for the year 1909, only :—

South Eastern	65·9d. per train mile.
L.B. and S.C.	56·8d. „ „ „
Great Eastern	53·6d. „ „ „
L. and S.W.	51·8d. „ „ „
L. and N.W.	51·7d. „ „ „
Great Western	49·4d. „ „ „



With the above results for long, passenger trains before us it is obvious that receipts amounting to 36d. per train mile for 3-coach trains, is a high figure. Let us, however, conceive that the receipts per train mile might be as much as 50d., and let us work out certain comparisons for three cases, namely, receipts of 34d., 42d., and 50d. per train mile. This is done in the following table :—

Gross receipts per train mile.	Service.	Amount which the lesser cost of the continuous-electricity system as compared with the single-phase system constitutes of the gross recipts per mile for a 180 ft. 3-coach train.	
		Difference in cost in pence.	Ditto in per cent. of the gross receipts.
34d.	25 miles per	3·5d.	10·3%
42d.	hour and one	3·5d.	8·4%
50d.	stop per mile	3·5d.	7·0%

It will be noted that only in the improbable case that the receipts amount to as much as 50d. per train mile, does the difference between the train-mile costs of the two systems decrease to as low as 7·0% of the gross receipts. Consequently it follows that the use of the continuous-electricity system in preference to the single-phase system for a service of this sort, permits of the allocation of at least 7·0% more of the gross receipts to reserves, dividends, etc.

The only capital costs which have been worked out have related to the electrical equipment, including sub-stations, contact-line installation, and rolling stock and its equipment. These items aggregate only £176,000 and £201,000 for the two respective systems. But the chief capital outlays are *in addition to* these relatively small sums. These further capital outlays will vary widely, and may, for such a 10-mile urban or suburban route, be anywhere from £500,000 to £2,000,000, according to the locality and the type of road. A higher expenditure, such as for a subway or for a deep-level tunnel (which, for a 10-mile road, would run to from £4,000,000 to £7,000,000), could not be made to pay with so light a service as is represented by an average of only five trains per hour in each direction.

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Let us consider a case where the further (and chief) costs amount to £1,000,000, for a 10-mile road. The corresponding total costs are :—

For the continuous system £1,176,000
For the single-phase system .. £1,201,000

The aggregate gross receipts will be :—

For 34d. per train mile £86,000
For 42d. per train mile £107,000
For 50d. per train mile £127,000

We have already seen that certain important items in the total cost (those, in fact, which are affected by the type of electrical system employed) amount to :—

For the continuous system .. 18·8d. per train mile.
For the single-phase system 22·3d. „ „ „

Let us take the cases where the remaining costs are respectively 16d. 20d. and 24d. per train mile, as these values cover the range which would apply to such a road and with such conditions of traffic. Let us denote these three cases as A, B and C. Then the total costs per train mile are :—

	Total costs per train mile.	
	Cont. system.	Single-phase system.
Case A When remaining costs are 16d. per train mile	37·8d.	38·3d.
Case B When remaining costs are 20d. per train mile	38·8d.	42·3d.
Case C When remaining costs are 24d. per train mile	42·8d.	46·3d.

The corresponding total costs per annum are given in the following table :—

Total Costs per annum.

	Continuous. System.	Single-phase System.
Case A	£88,600	£97,500
Case B	£99,000	£107,700
Case C	£109,000	£118,000

The net profit, or net loss, in per cent. of the capital outlay, is shown for all these cases in the following table :—

Table Showing Profits and Losses.

	Continuous System.				Single-phase System.		
	Receipts per train mile.	Profit or loss.	Profit or Loss. £.	Profit or Loss. per cent	Profit or Loss.	Profit or Loss. £	Profit or Loss. per cent.
	34d.	Loss	2,600	0·22	Loss	11,000	0·92
Case A	42d.	Profit	18,400	1·57	Profit	9,200	0·77
	50d.	Profit	38,400	3·27	Profit	29,500	2·46
	34d.	Loss	13,000	1·10	Loss	21,200	1·76
Case B	42d.	Profit	8,000	0·68	Loss	700	0·05
	50d.	Profit	28,000	2·38	Profit	19,300	1·60
	34d.	Loss	23,000	1·96	Loss	31,500	2·60
Case C	42d.	Loss	2,000	0·17	Loss	11,300	0·94
	50d.	Profit	18,000	1·53	Profit	9,000	0·75

So long as electrified sections constitute only a small portion of the suburban mileage of a main-line railway, the effect of small variations in the profit or loss on the finances of the entire railway may be negligible, but with extensions of the electrified sections the effect of the use of the less-economical system will become much more manifest.

It will be observed that in no instance is the return on the investment satisfactory. This draws our attention to another attribute of electric traction, namely, that an urban or suburban line involving large capital outlay must be intensely utilised. In other words, the train mileage per annum, per mile of line, must be high. Thus in the Underground and Tube railways in London, which have cost well on toward £1,000,000 *per mile*, as against the £100,000 *per mile* of our example, and with a service, at certain times of the day, of 40 long trains per hour in each direction there is an almost negligible margin between receipts and total costs.

If in our example we double the frequency of the trains, that is, if we operate a service with an average of 10 trains per hour in each direction (instead of only 5), then, assuming that (for the same fares) double the number of passengers can be induced to travel (*i.e.*, assuming the same receipts *per train mile*) the profits will increase to much more attractive proportions. This will be particularly the case for the continuous-electricity system, since the 100 per cent. increase in the rolling stock will, with the continuous-electricity system, involve a smaller increase in the capital burden than is involved in a 100 per cent. increase in single-phase rolling stock.

The results in this paper only apply to the particular service selected for the example. The less frequent the trains, the lower the speed and the greater the distance between stops, the less unfavourable to the single-phase system will be the results of such a comparison, but the less also is then the desirability of employing electricity, and by the time the point is reached where the single-phase system as at present developed, is more economical than the continuous-electricity system, the conditions are such that (except for very special cases) steam-locomotive operation constitutes at present the most economical system.

ELECTRIC LIGHTING PROSPECTS.

The Electric Supply Publicity Committee have apparently determined not to sit down under reproach, to judge by a very spirited rejoinder made by Mr. H. B. Renwick, the Chairman, in reply to an attack in an article in the " Financial Times " of the 10th inst. The article purported to deal with the financial outlook as regards electric supply undertakings, the writer charging the supply undertakings with not doing their best and properly pushing business. He pointed up his remarks by an attack on the Electric Supply Publicity Committee as representing the electrical supply industry, and compared this with the operations of the gas companies, whom he pretended had something of a similar organisation at work.

The Electric Supply Publicity Committee had, of course, something to say on the matter, and a letter appeared the next day from Mr. H. B. Renwick, the Chairman, in which he quickly demolished the erroneous statements made in the article. In the first place he showed conclusively that the gas companies had no similar organisation as the Electric Supply Publicity Committee ; and, further, that the operations of the Electric Supply Publicity Committee had been very extensive and the work done by the undertakings through them was of considerable magnitude.

The writer in the " Financial Times " made most unjust dispersions in his closing sentence :—" Considered as a whole, the business of electric supply has every prospect of success if those responsible for it shake off some of their traditional habits and apply themselves with vigour and intelligence to popularising the commodity which they have to sell."

Of course, the point of the article was mainly financial, but at the same time the writer covered municipal undertakings as well as company undertakings. It was fortunate, therefore, that an authoritative statement could be put forward by a body such as the Electric Supply Publicity Committee, which disinterestedly represented both municipal and company undertakings, and cut short any false impression which the article might have had on the public mind.

Institution of Electrical Engineers (Students' Section).—The next meeting will take place on Wednesday, November 30, at 7.45., in the Lecture Theatre of the Institution, Mr. P. V. McMahon, member, in the chair. A paper will be read by Mr. J. C. Rennie on " Tramway Brakes and Brake-gear." Gentlemen desirous of taking part in the discussion are reminded that a copy of the paper may be seen in the library of the institution.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

During the past week the scheme for reducing the capital of the Cleveland and Durban Electric Power, Ltd., has been carried into effect at an extraordinary general meeting of the shareholders at the Station Hotel, Newcastle-on-Tyne. The reduction is from £1,000,000 to £700,000, the cancellation representing capital lost or unrepresented by available assets. The capital cancelled consists of £5 per share on certain deferred shares held in trust by the company for the purpose of surrender, an amount of £4 10s. per share on other deferred shares, and £1 per share on some ordinary shares. Certain unissued deferred shares are cancelled, and one is divided into 10 shares of 10s. each, nine of these ten being cancelled. Opposition was made to the scheme by Mr. Gemmell, who wanted information concerning the Tyneside Electric Development Company, Ltd. It was explained that this company were the trustees for the second debenture holders. The Chairman made reference to a matter which was mentioned in this column a week or so ago, namely, the remuneration received by the consulting engineers. The net remuneration received for 4½ years of professional time, including practically the exclusive services of Mr. McLellan, was £4,900. Having regard to the waste heat developments which have taken place within that period, the amount does not appear unreasonable.

The Association of Mining Electrical Engineers.

On Wednesday, the 16th inst., the first meeting for discussion for the present session of the Newcastle branch of the above Association was held. The meeting was especially interesting, as it was devoted to an examination of the President's proposals regarding the tests to be made before the granting of certificates of competency. Conjointly with this the details of the examinations held under Government in New South Wales for certificates in mining electrical engineering were discussed, and it was generally agreed that these examinations should form the model, with certain modifications, for the Association. It was, however, suggested that the papers should be a little more practical, that a wider choice of questions should be allowed, and that an oral examination should be permitted for the older electricians who, while having practical proficiency, could not sit a written examination. A somewhat animated discussion was held as to whether a time-service of two years' actual experience as a colliery electrician was essential before the granting of a certificate, as it was pointed out that many contractors' men, who would be competent to instal and maintain such plants, would be debarred from obtaining a job at a colliery to the extent of the value of this certificate if the restriction were too closely made. It was also suggested that the examination should include questions concerning the lay-out as well as the maintenance of mining electrical plant.

Institution of Electrical Engineers.

Mr. H. W. Clothier, the lately-appointed honorary secretary of the Newcastle Local Section of the Institution of Electrical Engineers, has initiated an interesting method of eliciting electrical information by arranging a series of meetings during the present session for general discussion on subjects of interest to the members of the Institution. Whether this course has any relation to the arrangements which have recently existed with regard to the reading of Institution papers it is impossible for me to say. Whatever the cause, the result is excellent. During the present session three subjects for discussion have already been arranged, and in each case the discussion will be opened by a member who is well versed in the selected subject. The first of the series, which was held on Monday last, was upon Electric Winders, when Mr. J. G. Wilson opened by briefly describing the characteristic features of the different types of electric winders in common use. He was followed by other speakers, including Mr. Gerald Stoney, Mr. W. C. Mountain, Mr. A. W. Woodyatt, etc., and the evening proved a very interesting one, further particulars of which will be given in the next issue of this journal. This meeting is to be followed by a similar symposium on Cables. to be opened by Mr. Charles Vernier, of the Newcastle-upon-Tyne Electric Supply Company, Ltd., who has had unique experience in this direction, and another upon Test Room Equipment, to be opened by Mr. E. Fawcett. Altogether, this new departure will be watched with considerable interest.

A Smart Piece of Work.

Credit must be given to the Newcastle and District Electric Supply Company, Ltd., and to Messrs. Robson & Coleman for a very smart piece of change-over work which was accomplished under unusual conditions. On Wednesday morning, the 16th inst., the gas engine attendant at Messrs. Robinson's printing works, in this city, in starting up his engine, discovered that the crankshaft was broken and that the base of the flywheel was cracked. The engine was a large one—about 70 B.H.P.—and if the attendant had not been smart in detecting trouble the consequences might have been very serious. As it was, the machinery of this seven-storey building was laid idle and about a hundred employees put out of work. The electricity supply company was communicated with and, in conjunction with the above firm of electrical contractors, three motors were found and put on site. The first, of 35 h.p., was on site by 5 o'clock on Wednesday, and was wired up and running early next morning. The second 35 h.p. motor was running first thing on Friday morning, while the third, of 25 h.p. capacity, was ready for running by Saturday morning. One motor was placed in the basement, one on the second floor, and the last on the fifth floor. The motors were bolted into the floors and the cables run and cleated into position, while part of the work was of a very arduous description. Full credit must therefore be given for this smart piece of work, which emphasises the advantages of electricity supply.

The Launch of the "Weymouth."

The optimists amongst us are taking comfort in the fact that at last there has been a ship launch of some importance on the Tyne. On Saturday last the second-class cruiser "Weymouth" was launched from the Elswick shipyard of Messrs. Sir Armstrong Whitworth & Company, Ltd. Probably it would have been launched earlier but for the lock-out. The vessel is 430 ft. long, and has a displacement of about 5,000 tons. Her armament includes eight 6-inch guns, and she is turbo-driven, the turbines being built by Messrs. Parsons. Electrical engineers will, of course, be interested in the equipment which is now a necessity of every large vessel built for the Admiralty, and it is pleasing to reflect that in this vessel and its machinery there is, at any rate, one reason to keep the electrical power supply running to feed Tyneside industries.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The Birmingham Local Section of the Institution of Electrical Engineers has for its chairman for this, the eleventh Session, Mr. M. J. Railing, Managing Director of the General Electric Company, Witton. Mr. Railing,

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though comparatively a young man, has won for himself a remarkable position in the electrical engineering world. He is a native of Munich, but, like many others among his compatriots who have come to England to seek their fortune, he has given his adopted country his whole-hearted devotion. Evidence of this feeling is to be seen in the tone of his inaugural address. About twenty years ago, when almost fresh from school, Mr. Railing joined the staff of the General Electric Company in the accountants' department. He showed an appreciation of the technical side of the business and such ability on the commercial side that he won rapid promotion and for ten years he has occupied a leading position in the direction of the company.

Growth of the G.E.C.

The firm has had a remarkable growth. It started some 25 years ago with the proverbial "man and a boy," and now has a capital of over a million, with works at Salford, Witton (Birmingham), and departments at Sherlock-street, Birmingham. The General Electric de France is an allied concern. Since the main part of the manufacturing department was transferred from Salford to Witton, ten years ago—a period which coincides with Mr. Railing's management and service on the Board—they have grown very considerably. About 1,500 hands are employed, and motors and dynamos are produced from the smallest capacity up to 5,000 kw. Almost every branch of electrical manufacture is carried on by the company, including Osram lamps and telephone work. The manufacturer of carbons has in recent years become one of the leading features, and the firm contracts for the Admiralty and other home and foreign Government Departments.

A Happy Family at Witton.

Mr. Railing's administration is characterised by the promotion of the utmost good-feeling between employers and employed. The works at Witton have adjoining them allotments which are let to the hands and cricket and football grounds provided for their recreation. Various organisations for social enjoyment and mutual help amongst the workpeople and staff have been formed. Among these, there is an orchestral band which meets regularly for practice, and some members of which contributed to the enjoyment of Mr. Railing's guests when, after the opening meeting of the session, he invited the members of the Local Section of the Institution of Electrical Engineers to finish the evening with him at the Grand Hotel.

Importance of the Commercial Instinct.

At the Institution meeting, which was held as usual at the Birmingham University buildings, in Edmund-street, the attendance was the largest yet recorded, members from a distance being present in exceptionally large numbers. The chairman's address evidently made a strong impression, especially that part of it dealing with the importance of a commercial training forming part of the education of an electrical engineer, if England is to regain her lost ground, in competition for the world's trade. At the conclusion of his address, Mr. Railing congratulated the Section upon having in the retiring chairman, Mr. Morcom, a gentleman who was not only eminent as an engineer, but whose commercial abilities were generally recognised. There could be no better evidence of this recognition, he said, than the fact that Mr. Morcom had just been appointed a director of Lloyd's Bank.

University Men and Commerce.

That the line the chairman had taken in his address strongly commended itself to the meeting was evidenced by the remarks made in proposing a vote of thanks to Mr. Railing. Colonel Lister said that the paper would set large manufacturers thinking about the class of men they sent abroad and would no doubt be helpful to young engineers in deciding as to the course they should follow in their training if they wished to get to the top of the tree. He himself thought that unless a man added some commercial training to his University training and works experience, he could not hope to succeed in life so well as a man who enjoyed all these advantages. Too often a young man coming from the University regarded commercial considerations as infra dig. for him. He had had some instances of that, but he hoped, for the sake of the prosperity of the industry, that feeling would pass away. The seconder of the vote of thanks, Mr. Barker, joined issue with Mr. Railing on one point, namely with regard to the telephone as a means of distributing knowledge. He thought the thing chiefly facilitated by the telephone was bad language.

Not a Model Commercial.

With regard to the commercial traveller, the chairman, Mr. Barker remarked, had given them some valuable hints. While it was desirable for an engineer to have some commercial knowledge, it was also necessary that a traveller should know something of the trade he represented. For instance, he once received an order from a traveller for so many thousand kilos of copper articles "made of the best sheet brass." Mr. F. Brown, of Walsall, said that Mr. Railing had omitted one point in favour of the British manufacturer and merchant, and that was his reputation for probity, honour, and honesty. They had always held that in the case of an English trader his catalogue and his word were as good as his bond, but there were some other countries to which that statement did not extend. At the conclusion of the meeting, the members, on the chairman's invitation, adjourned to the Grand Hotel, where vocal and instrumental music and light refreshments were provided.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

It is a remarkable fact that the first town to be fed from a 110,000-volt current was Berlin, in Ontario, as, although we in German Berlin are not quite so up-to-date, Prussia has now an electrical supply leaving the works at that tension. This development was brought about in the following way. The Eisen und Stahlwerk A.G., Lauchhammer, has several branches in various places, each of which has hitherto found its own power. Lately, however, it has been found that under the chief works at Lauchhammer there is a huge deposit of brown coal, which it is obviously advisable to exploit. Hence the company decided to erect a big station. At the same time plans were being drawn up for a large station at Gröditz, near Dresden, where there are large ironworks. The result has been to combine the two projects. The company and the municipalities have already put up three turbine aggregates, each of 5,000 kw., and two more will be laid down, and, as already stated, the current will leave the generating station at 110,000 volts, a tension obtained from the 5,500 volts delivered by the dynamos by means of four rotary current oil transformers, each of 6,800 k.v.a. When the installation is complete the total output of the transformer will be 40,000 k.v.a. (say, 50,000 h.p.). The radius of action of the new station is about 30 miles.

German Enterprise at Jerusalem.

Thanks to the German colony in Jerusalem, that city is to have electric lighting, electric trams and telephones. This modernisation is already in course of execution. Telephonic communication will be established between Jaffa and Bethlehem.

Electric Iron Smelting.

German interest is greatly aroused in the proposal to utilise the power of the Tinfos, which is estimated at 15,000 h.p., to supply the energy for electrifying the whole of the Tinfos Ironworks. By the summer of 1911 it is estimated that one-third of the power will be in use for the electric furnaces, and that 12 months later the head of water will be fully utilised.

A New Accumulator.

A new nickel and iron storage cell has found its way to the German market. The positive plate weighs 540 grammes and has a capacity of 37 ampere hours. Twenty-nine perforated nickel tubes contain the active mass and are wrapped round with nickel wire. The nickel plate consists of corrugated strips of iron fixed in a frame and

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coated with an easily reducible oxide.' Its weight is 140 grammes and its capacity is 15·4 ampere hours. A battery containing five positive plates and six double negative plates gives fully charged 1·55 volts. On discharging at 20 amperes, the voltage is 1·45 for the first hour, and 1·2 for the second. It then sinks much more slowly down to 0·8 after six hours. Hence we get the favourable result of 120 ampere hours, or 130 watt hours, for an accumulator weight of only 6¼ kg.

Electricity in Cultivation.

Dr. Breslauer, of Potsdam, has been making some important researches in the application of electricity to agriculture. These are the more important as they were tried over a larger area than usual, viz., about 135 acres. Tinned steel wires 1-30th inch in diameter were stuck into the ground eleven yards apart, and rising to heights of from 14 to 16 feet above the surface. They were all connected above with the positive pole of a current generator, the soil serving as the negative pole. An ampere meter connected with the subterranean connections showed that in dry weather the average current through the whole system was half a milli-ampere, while the difference in potential between the poles measured by means of a spark gap between balls one inch in diameter was 65,000 volts. The energy expended in accelerating the growth of the crops was only 0·00028 watt per square metre, or, say, one watt per acre. This expenditure was well repaid by the "manuring" effect of the electricity.

The Gyroscope Mono Rail.

Unfavourable criticism is raised by G. Martienssen in a German paper against the Scheil and Brennan mono-rail systems. The critic declares the principle untrustworthy on curves except at a very low speed, and concludes that the system can never be applied to passenger traffic, but to slow goods traffic only. For this purpose it is possible that there is a future before the Brennan system, especially in hilly districts, where it would save much expense in surveying and construction. In such case, however, it will still have to compete with the hanging railway with the overhead rail.

Germany's Attitude Towards the Turin Contest.

The Italian scheme of having a competition between telegraphists at the Turin Exhibition of 1911 is having a mixed reception. Germany and Hungary are taking no part in it, and rightly so. The conditions of the competition are utterly different from those which regulate the daily work of telegraphic operators in Berlin. Austria, France, Belgium, Turkey, Servia, Brazil, the Argentine Republic, and Greece have all signified the intention of their governments to co-operate, and unofficial co-operation is announced from Switzerland, Sweden and Tonkin.

Company Affairs.

The Elektro-Mechanische Fabrik, R. K. Geissler & Company, is to be made a limited company, with a capital of 750,000 rubles.

The Nurnberger Herkules Werke A.G. is an excellent example of how small concerns can pay a first-class dividend. Although the capital is one million marks only, 8% is paid regularly as dividend. A concern of this sort can always find abundance of capital should it have good reason for enlarging its business.

The Aktiengesellschaft fur Elektrizitats Anlagen, Berlin, has been busy absorbing smaller concerns. It has also, as a result of negotiations with the municipalities of Saalfeld, Rudolstadt, etc., founded a branch concern under the title of Saale-Elekbuzitatswerk G.m.b.H. It has severed its connection with the Petersburg Gesellschaft fur Elektrische Anlagen. In spite of all these changes, the net profit has increased from 538,629 to 602,289 marks, with a corresponding increase of dividend from 6 to 7% on the capital of seven million marks. The carry-over is 111,923 marks.

The Elektrizitats Genossenschaft Niederhausen, Eingetragene Genossenschaft G.m.b.H., is a new company formed at Landaar, a.I., for the purpose of undertaking the building and working of an electrical station for supplying light and power. The capital is 400 marks for each branch of the business. The number of branches is limited to 10. The board consists of Mm. Schmidlhofer, Deindl and Busler.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

Both in the Old World and the New engineers and inventors have for many years been seeking a device wherewith to minimise the mortality occurring at railway level-crossings. The records at the patent offices of all countries are full of more or less ingenious contrivances to this end, but none has yet been found to answer all the requirements demanded. These are, broadly, that at all level-crossing approaches an alarm shall be given which will indicate the approach of a train to the deaf, dumb, blind and illiterate; that the warning signal shall be both audible (for the blind), and visible (for the deaf), and that to the illiterate it shall convey its caution in unmistakable terms; and finally that in its operation it must be wholly independent of human agency, save in so far as occasional inspection is concerned. All these conditions in combination aggregate into rather a large order and that order has not ye tbeen executed. But science is getting nearer to it by degrees, and a device which is being placed on the market in this country by the Gill-Alexander Electric Company, of Denver, gives promise of going a good way towards the end in view. At the crossing, mounted on a pole of suitable height, is a vibrating electric gong, over which is fixed an electric lamp in ruby glass which gives, when operated, rapid intermittent flashes. At the base of the gong-pole is a weather-proof battery-box with wires connecting with line wires extending in both directions parallel with the track to both ends of the protected section. At each end of the section there are placed below the rails, at intervals of 300 feet, or such other distance as may be found most effective, three oscillators, each provided with three contacts. When a train approaches the protected section the vibratory motion which it imparts to the rails causes the oscillator to close the circuit and ring the bell at the crossing, and the bell continues to ring, and the danger light to flash, as long as the vibration caused by the train continues. The oscillator is encased in a tube which is dustproof and waterproof, and is thoroughly insulated. Its installation is simple, and it is claimed that it is effective under all conditions of operation.

Electric Pumping.

One of the most extensive applications of electric power to sewage pumping purposes in this country is now in course of installation in Chicago, two screw pumps, with impellers 14·75 feet in diameter, being now driven from an induction motor through a double-reduction train of gears. The motor is a 750 h.p. three-phase machine operating at 2,300 volts and 60 cycles. It is of the slip-ring type with 12 grid resistances in the rotor circuit. Its speed is 435 revolutions per minute; the gear ratio is 8·25 to 1·0 and the face of the four gears is 18 inches each. The motor is set at the bottom of the engine pit 14 feet below lake level. In size it seems a pigmy beside the big engines that rise to a height of 35 feet alongside, but it has the same power as each engine of pumping 40,000 cubic feet of water per minute. Current is supplied to this station by 12,000-volt underground cables from the terminal station of the Sanitary District's hydro-electric transmission system. Step-down transformers reduce this to 2,300 volts for use by the motor. This pumping station is now operated by the Sanitary District and the pump just started is the first of what will likely become the exclusive electric pumping of Chicago's interrupted sewage and water for sewage dilution and probably the electric pumping of a considerable part of the city's fresh-water supply.

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The Equipment of a Battleship.

A striking exemplification of the increasingly important part taken by electricity in the equipment of a modern battleship is afforded by the details of the motor installation of the "North Dakota," our new 20,000 ton warship. Four 300 kw. turbo generators, running at 1,500 revolutions per minute, supply 125-volt direct current to 10 25 h.p. motors to operate the hydraulic speed gears for turning; to 10 40 h.p. motors for the upper hoists; 10 17 h.p. motors for the lower hoists; 10 15 h.p. motors for gun elevating; 10 10 h.p. motors for rammers; 10 3½ h.p. motors for operating gun breaches; five 1¾ h.p. motors for ventilating vans; two 40 h.p. motors at the boat cranes for hoisting, and two 30 h.p. motors for rotating; seven 35 h.p. motors for deck winches; four four h.p. motors for the five-inch ammunition conveyors; 14 3 h.p. motors for the five-inch chain ammunition hoists; four 3 h.p. motors for the 12-inch ammunition hoists; 17 ¾ h.p. motors for operating water-tight doors; six 1¾ h.p., 12 3 h.p. and four 6½ h.p. motors for the ventilating fans; four 4 h.p. motors for elevators; 14 30 h.p. motors for forced-draught Sirocco blowers; two 80 h.p. motors for torpedo air compressors; one 30 h.p. for turbine hoist; and others of various powers for freshwater pumps, laundry machinery, dish washers, dough mixers, and kindred appliances. There are also gun-firing motor generators, danger-zone indicators, eight electric searchlights, 28 arc lamps, 2,330 incandescent lamps, complete sets of running and signal lights, a 5 kw. wireless outfit, an illuminating set for a thousand 16 c.p. lamps, and numerous other appliances all electrically operated, some 2,400 h.p. being represented in motors alone. There are two distribution rooms, one forward and the other aft, the maximum battle load on the former being approximately 5,735 amperes, and on the latter 2,651 amperes. Of the four 300 kw. generators one can carry ordinary cruising load, two can carry the entire cruising load at high speed with all forced draught blowers running, and three can supply all the energy required for all purposes under severe battle conditions. The equipment of the "North Dakota" is illustrated and described in detail in the current issue of the "Electrical Review and Western Electrician," of Chicago.

The Electrolysis Decision.

The decision in the famous Peoria electrolysis case, which, as indicated in these Notes last week, has an important bearing wherever electric railways are operated, is the subject this week of exhaustive comment on the part of the technical journals, all of which regard it as a decisive victory for the Peoria Electric Railway Company. The "Electric Railway Journal" observes that "it can fairly be admitted that many of the early railway return circuits were very inadequate. Large losses in transmission were looked upon with equanimity by railway managements, and undoubtedly in many cases the railway return current made wide excursions and took all sorts of paths to get back to the power station. As in the telephone litigation, the opponents of the electric railway saw no relief, or claimed to see no relief, except through the introduction of a double-trolley system." After tracing the history of the case from 1893, the writer observes that by September of the current year charges of damage similar to that wrought by the Peoria Railway were being brought against electric railway companies generally, and by almost general consent Peoria was selected, like Waterloo, to be the decisive battleground of the two systems. But, continues the writer, "the situation was complicated because laboratory experiments showed that under favourable conditions a fraction of a volt was sufficient to cause electrolysis. Hence the hasty assumption was reached that this slight difference in potential between the rails and the water pipes would cause electrolysis and that the extent of the electrolytic corrosion at any point was always proportional in the difference in potential. The fundamental error in this theory is that current, not potential, causes electrolysis, and this point is clearly brought out in Judge Sanborn's decision, which, we hope, will conclude the litigation between the owners of underground metallic structures and railway companies so far as electrolyiss is concerned. During this contest the electric railway return circuit has been made the scapegoat for a great variety of corrosion in water systems. It was even gravely alleged that electric railway return current had seriously injured the shell of a standpipe at a point several feet above the surface of the ground and some distance from the track. Other charges almost, if not quite, as absurd against the electric railway circuit were made in other cities, and we are glad to see under the sanction of a court ruling the expression of a more sane view in regard to this matter. The adoption of the cumbersome and insufficient double-trolley system was unthinkable, and, besides, would not have given assurance that the damage would cease. The immense advance in the development of rail bonds has done more than anything else to improve the situation. With good and adequate rail bonds and supplementary return very little else is needed on most systems, but if additional precautions are reqiured, and their need can very easily be determined, there are ample remedies for the trouble which can be applied."

A Great Electric Company.

The wonderful aggregation of workshops in which have been made three-fifths of the telephone apparatus of the world forms the subject of a striking article by Mr. H. N. Casson in the "Telephone Review." The Western Electric Company, he says, is an enterprise of 26,000 man-power and 70,000,000 dollar-power, and it produces every day in telephone material alone goods worth $200,000. The Western Electric was born out of the ashes of the great fire of Chicago in 1871, but it was not until seven years later that the company took up the manufacture of telephones, and to-day, in addition to their general factory in Chicago, they own and operate eleven other important works scattered over the earth between New York and Tokyo. In the Chicago plant, says Mr. Casson, is the mad waltz of spindles that whirl silk and cotton threads around the copper wires, and here 5,000 electric lamps are made every day. Here wire is wrapped with paper tape at a speed of 9,000 miles a day. Some is fashioned into fantastic shapes that look like absurd sea monsters, but are in reality the nerve-systems of switchboards, and some is twisted into cables by means of whirling drums. No other company use as much wire and hard rubber or as many tons of brass rods as the Western Electric. Of platinum, which is dearer than gold, it uses 1,000 lbs. a year in the making of telephone transmitters. To every telephone message seven countries contribute—the Ural Mountains supply the platinum, Italy and Japan the silk thread, Norway the iron for the magnets, Manila the paper tape, South America the mahogany, Brazil and the Congo the rubber.

THE ASSOCIATION OF MINING ELECTRICAL ENGINEERS.

A general meeting of the recently-formed East of Scotland Branch of this Association was held in the Carlton Hotel, Edinburgh, on Saturday evening, the 19th inst., when the opening address for the Session was delivered by the acting President, Mr. H. Gordon Fraser, Electrical Engineer to the Fife Coal Company, Leven. Dealing first with the objects of the Association, Mr. Fraser said that the object of the Association was to promote the necessary knowledge required for dealing with electrical engineering in colliery work and in bringing mining managers and officials, and electrical engineers, manufacturers, and consulting engineers, together. It was hoped by mutual exchange of ideas and results of experience, to vastly improve the application of electricity to colliery working, and in other ways to foster and protect this branch of the industry, and increase the safety of the pits themselves. He touched upon some questions relating to "earthing" systems for collieries, and upon proper design of switchgear and other plant, and a short discussion took place on these points. The meeting unanimously confirmed the appointment of Mr. Thos. Davidson, 16, Rutland-square, Edinburgh, as hon. secretary of the branch. Mr. C. Augustus Carlow (Fife Coal Company) has accepted the office of hon. president of the branch, and 12 members of council for the ensuing year have been elected.

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POSSIBILITIES OF WATER POWER.

While subscribing unconditionally to the soundness of the economic laws underlying the great scheme put forward by Mr. de Ferranti in his inaugural address, we must recognise that under existing conditions we shall probably have a long time to wait before such a wise conservancy of energy can be brought about. Meanwhile there are certain other phases of conservancy of energy worthy of attention, and notably so as regards the utilisation of water power. The economical harnessing of what our Continental neighbours call "white coal" divides itself into two branches: the large schemes requiring great volumes of water and considerable falls, and minor installations which need only moderate volumes of water with very slight falls. Of the first division there is comparatively little chance in these islands. But with regard to the second division, there is ample room for development. We already possess several most successful types of these small hydro-electrical installations, not only in more hilly districts of Wales and Scotland, but in flatter England. In one or two cases villages and small towns are lit and supplied with electric power generated by local streams. In far more instances private persons have electric installations of this description for the supply of their mansions, estates or industrial enterprises. Occasionally we find a happy mixture. For instance, Mr. J. A. Farrer, of Ingleborough Hall, Clapham, has an hydro-electric installation which not only supplies Ingleborough Hall, but a large sawmill, the Parish church and reading room, and lights the village streets. Then there is the case of the Duke of Atholl, at Blair, described in our Notes. The Ingleton Electric Lighting and Power Company, Ltd., with a modest capital of £7,000, has constructed a weir on a local stream, and by means of a pipe line has secured a head of 27 feet, which runs two 20 h.p. horizontal "Vortex" turbines, coupled

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to two dynamos, and supplying electricity for thirty-seven 32 c.p. street lamps, about 2,000 lamps for private lighting, and power for six consumers. At Grassington, as our readers know, a weir already existed across the River Wharfe, so the expenses of installation, including turbine and dynamo, etc., came to under £1,000. The point is that such schemes as these could easily be multiplied enormously, in districts where it would be either impossible or too expensive to secure supply from some central generating station. In these days when electricity is being introduced into cottages this is worth considering. It is noteworthy that in many parts of Italy and Spain villages and peasants' cottages are lighted by electricity, thanks to the cheapness of water power as a means for generating electricity. As regards Italy, the supply is generally by way of sub-station transformers, the bulk supply being derived from some huge hydro-electric scheme primarily installed for the benefit of distant industrial centres. But in Spain smaller units are the rule. A Scoto-Spaniard, writing on this point, says: "We think of Spain as so conservative that she remains immovable in the midst of invention and improvement. Take this fact—throughout rural Spain the light used is the electric light. The electricity is cheaply produced by water power, and there is scarcely a peasant's house, however remote, but is lit by the electric light." It would be well for the public and the industry if we saw more of this kind of thing in this country.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the apparance of the questions.

ANSWERS.

Question No. 1232.—What is the most modern practice of arc lighting where the lighting is scattered over a very large area with long distances between each lamp as for dock or railway lighting; a number of 50 lamps being so placed that they would cover a length of run of some six miles from and to generating station? In considering the question, the lighting is to be so arranged that any lamp can be switched on or off as required according to the work going on in the locality, with a corresponding saving in power on switching off; and also provision to be made for installing any further new lamps at any point. Discuss the alternatives considering the capital cost and running charges of the long series constant direct current system with its single run of cable and low generating efficiency, and the short series parallel system across, say, 440 volts, and the long series alternating system with constant current transformer. Providing the long series constant current system gives the most advantage in efficiency, cost, flexibility and general lighting, what is the most efficient way of generating the current, the most modern dynamo, and how to be driven, seeing the small kilowatt capacity of the unit.

Reply to Question No. 1232 (*awarded* 10s.).—Modern practice in arc lighting involves the use of flame arcs (the most efficient source of artificial illumination yet discovered) wherever possible. The disadvantages of this type of lamp are—the high cost of impregnated carbons, the greater delicacy of the lamp mechanism, and the comparatively short burning hours. "Magazine" lamps obviate the latter objection, but the former remain rather serious in such a case as the present. In America, where labour is very costly, improved enclosed arcs are considerably used for such services as the present, owing to their long burning hours and low attendance costs.

The long-series or constant-current system of arc lighting is comparatively common in America, but is little used in this country, mainly owing, probably, to the legislative restrictions which (very properly) control the use of high tension current. It is shown below that, apart from such considerations, the series system has little to recommend it in the present instance.

Kilowatts required: Illumination obtained.—The total kilowatts required by the proposed installation is very small. Assuming the use of flame arc lamps of an efficiency of 0·30 watts per candle-power (higher efficiencies *can* be obtained, but such figures as 0·15 watts candle-power are at present hardly more than laboratory test results) and 2,500 c.p. units, the total kilowatts required by 50 lamps

$$= \frac{50 \times 2{,}500 \times 0{\cdot}3}{1{,}000} = 37{\cdot}5 \text{ kw.}$$

or, allowing for losses in transmission, future extensions, etc., a total of 50–70 kw. should be allocated to the system.

Assuming 40 volts per lamp, the current taken by each

$$= \frac{2{,}500 \times 0{\cdot}3}{40} = 19 \text{ amps. approx.}$$

According to whether a good light is needed in the immediate vicinity of each lamp or whether as uniform an illumination as possbile is required over the whole yard, the lamps should be slung 30–50 or 60 ft. above ground level. Suppose that in the present case the height of suspension equals 35 ft.

The wording of the query is not very clear on this point, but I gather that 50 lamps have to be arranged on a more or less "ring" route six miles in length, so that the pitch of the lamp-posts equal about 210 yds. (exceptionally great; 100–150 yds. would be better). The mean illumination then obtained would be about 0·22 candle feet; the maximum illumination (below the lamp) would be about 2 candle feet, and the minimum illumination (midway between lamps) would be about 0·005-0·006 candle feet (the latter = 4 to 6 × natural illumination on a starlight but moonless night, and = ¼–⅛ × illumination due to the moon on an average clear night).

Choice of System.—In an installation consuming only some 40 kw. the efficiency of generation cannot alone govern the choice of system, since the difference between the energy cost of the various systems available will be outweighed by the more abstract factors in the problem (the capital cost of the lamps, poles and cable system being much the same in each case—see later).

The alternative schemes in the present instance are:—

(1) To run 50 lamps on the series circuit requiring about 2,000 volts at the terminals of the latter.

(2) To run 10 lamps on each of five circuits, the supply pressure being 400 volts.

(3) To run 10 lamps and one spare "point" on each of five circuits, the supply pressure being 440 volts.

The spare "point" in method (3) must be occupied by a substitutional resistance (inefficient) if direct current be used, but may be occupied by a "choker" (consuming very little energy) if alternating current be employed.

The long-series, constant-current system (whether D.C. or A.C.) enables the efficient insertion or renewal of a lamp from any part of the circuit at any time, but, when using the short series (constant V) system, complete batches of 10 lamps must be put in or out of circuit together *or* more or less inefficient working by means of substitutional resistances or chokers must be tolerated. In this respect the series system possesses undoubted advantage, but there its advantage ceases (in the present case). A D.C. 'arc-lighter" dynamo has frequently 10–15% copper losses (though this fact does not influence the present case greatly). The danger to life from the use of the high pressure

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necessitated, even by such a small installation as the present one, is considerable, and special conditions of working would be enforced by the B.O.T.

Nor would the high-tension system save appreciably in the cost of the cables required, for the long-series system would require about 6¾ miles of 20 amp. 2,000 volt cable lead sheathed and armoured, and costing about £2,000–£2,200; while the low-tension (440 volts) scheme, using armoured and braided cables, would need about 10¾ miles of 20a., 5 miles of 40a., and 1¼ miles of 60a. cable, costing in all some £2,200. In view of the small amount of power involved, I should recommend working from the existing 440 D.C. supply. Otherwise, 440 volt A.C. supply or, if considered advisable in spite of the above remarks, long-series A.C. working (by step-up, constant current transformation from L.T. mains) could be adopted. I should certainly think that a special direct current (constant current) generating plant would *not* be justified in the present case.

As a general rule, it is not desirable to use higher pressures than 400–500 volts in dock and railway yards, etc., unless for some special reason; in the present case, even at a somewhat greater monetary cost, a low voltage system should be employed. On such a small installation, any loss of efficiency and increase in capital cost traceable to this decision will be inconsiderable. On a big system, employing hundreds of lamps, constant current working would be very desirable, the resulting economies then fully compensating for the well-known drawbacks to the system.

In cases of the present description, where a few sparsely distributed lamps are required, high pressure coal gas, acetylene, petrol gas, water gas and a species of gas-heated Nernst lamp have all been very economically applied. Such lamps are not so efficient as flame arcs, but the much cheaper form of energy employed more than compensates for this, and the cost of a suitable pipe line (in those cases which are not "self-contained"), surface-laid over much of the area of distribution, will generally be much less than that of an armoured cable which, besides being itself costly, needs more careful laying and general treatment. The claims of these rival systems certainly merit consideration in the present case.

Cut-Outs.—If a constant voltage supply be adopted, each lamp will have to be provided with the ordinary type of automatic cut-out switch and substitutional resistance (or choker), and, if individual lamps are to be switched off at times, hand switches enabling the insertion of the substitutional choker (there will be no advantage in switching out single *D.C.* lamps in such a case) must also be provided. On a constant current system, automatic and hand-operated short-circuiting switches will, respectively, guard against accidental breakdowns and enable isolation of any required lamp. No substitutional load will be required, but the automatic cut-outs must be provided with a double (V and C) winding.

Miscellaneous Data and Costs.—The St. Louis Exhibition grounds were lighted on the constant current A.C. enclosed arc system. Groups of 100–6½ amp. lamps were fed, in series, by 60 kw. 7,200 volt transformers; several accidents were attributable to the H.T. supply.

The efficiency of open flame arcs varies from 0·27–0·29 (good) to 0·4–0·7 (very bad) watts per candle-power, while good enclosed flame arcs operate at 0·25 watts per candle-power. Note also that flame arcs lose far less by operation on A.C. supply than do ordinary (pure carbon) arcs; probably because, in the former instance, the majority of the light comes from the *arc* itself.

Loss of light by clear arc globes equals 8–15%, "ground" globes 15%, "opal" globes 20–30%.

Cost of flame arc lamps £6-£7 each + say, £2 accessories per lamp.

Cost of enclosed pure carbon lamps £5 each + say, £1 10s. accessories per lamp.

Poles: £5–£10 each; should be near the lower figure in the present case.

Running cost per year, including capital charges (on lamps, poles, cables, etc.), carbons, maintenance and attendance = £10–£12 per year (burning dusk to dawn: energy 1½d.–2d. per B.T.U.).—"W. M."

THE "PIGG'S PEAK" GENERATING PLANT.

The new generating plant, installed at the order of the Pigg's Peak Development Company, according to the "South African World," is situated about 5½ miles from the battery, on the M'Popinyaan River, from which a steel fluming conducts the water for a distance of 700 ft.; the fluming has a sectional area of 6·5 square feet, and a fall of one foot in every 100 feet. The race into which the fluming delivers the water extends for a distance of 1,400 feet along the southern side of the river and ends at a point 277 vertical feet above the power-house. The water is led to the wheel through a sluice valve and a pipe column of 700 feet in length and 30 inches in diameter, having a thickness of metal of 0·25 inches. Formally the power plant consisted of an old-fashioned turbine which drove a generator by belt. The new plant consists of a Pelton wheel and direct-coupled generator, as hereunder described. The machine is a double-wheel, four-nozzle Pelton wheel governed by a hydraulic governor which is driven by a small motor and silent chain. It is designed to develop continuously 300 b.h.p. when supplied with about 750 cubic feet of water per minute under a head of 277 feet vertical running at 428 revolutions per minute. The sensitive hydraulic regulator controls the area of jet from the nozzles with the aid of slippers. The machine is fitted with an emergency governor, and the two top nozzles are fitted with Spear regulators. The Pelton wheel is coupled direct to an E.C.C. 200 kw. generator, equivalent at 75 power factor to 267 k.v.a. at 3,300 volts and 50 cycles, and runs at 428 revolutions. The temperature rise of the generator is guaranteed not to exceed 70 degrees Fahrenheit above the surrounding air on full load running conditions. The plant has been constructed and erected by Messrs. Hubert Davies and Company, Johannesburg, the makers of the Pelton being Messrs. Gilbert, Gilkes, and the alternator by the Electric Construction Company, Ltd.

Current is transmitted overhead over a distance of six miles, on six strands of No. 6 hard-drawn copper wire. Three wires were used for transmitting current from the old turbine plant and three new wires are being added.

Three single-phase 50 kw. transformers 3,000/500 are being installed, also one three-phase 35 kw. transformer now in use. The mill is equipped with a 135-h.p. E.C.C. motor, 500 volts, 50 cycles. The mines are equipped with double-drum electric hoists, which are worked by motors of 15 h.p., 500 volts, 50 cycles. The hoists are designed to haul about 2,000 lbs. at a rope speed of 200 ft. per minute. The controller is of the tramway type, with resistance for starting and reversing the hoists.

The mine pumps are Tangye vertical triplex pumps 4 inches diameter, 6 inch stroke, and are fitted with three-phase motors, 500 volts, 50 cycles full-load speed, 1,410 revolutions per minute. The motor is fitted with raw hide pinions for direct driving the spur wheel, which is on the counter shaft of the pump.

LONDON'S ELECTRIC RAILWAYS.

A Parliamentary Bill is being promoted by the Metropolitan Railway and the District Railway for power to purchase or take on lease from the Underground Electric Railways Company of London the generating station at Lot's-road, Chelsea. It is proposed to appoint a joint committee of the two companies, which will undertake the management of the concern and supply electrical energy for the two railways and to any outside undertaking. It is also proposed to build two sections of line to form junctions between West-end sections of the District Railway. Both sections will form links in the line between Lillie Bridge and sidings, Fulham and Warwick-road, Kensington. The District Company also seeks power to acquire and work "omnibuses, cabs, and other like vehicles, whether horse-drawn or mechanically propelled," and to subsidise similar enterprises by other companies.

Among various proposals in a Parliamentary Bill in promotion by the London Electric Railways is one to extend the Bakerloo tube from the present terminus at Edgware-road to Paddington-station.

The London and South-Western Railway Company is also seeking powers for the widening, extension, and improvement of Waterloo-station.

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INFLUENCE OF PURE SCIENCE IN ENGINEERING.*

By Sir J. J. Thomson, F.R.S.

Though I am not an engineer, I started life with the intention of being one, and studied engineering for some years at the Owens' College, Manchester, under one of the most profound and original engineers this country has produced—Professor Osborne Reynolds. Indeed, I found, the other day, when consulting the Calendar of the University of Manchester in the hope of discovering something that would justify my presence here this evening, that I am the possessor of a certificate of proficiency in engineering. The reason I had to abandon the engineering profession was that at the time I was a student the usual method of entering the profession was to become an apprentice to some well known firm who charged very heavy fees for this privilege. Owing to the death of my father before I had completed my course at College, I was not in a position to pay the necessary fees, and had to direct my attention to other pursuits. I have no reason to regret this decision in my own case. Yet I cannot help thinking that the system which led to it was a bad one, and that the practice which prevails. I believe, in the largest and most important firms in the United States, of giving the opportunity of a trial to practically any one who distinguishes himself in the engineering schools of the country, is far sounder and wiser even from the commercial point of view. Surely, even as a matter of finance, it must be far more important to a firm in a large way of business, who must necessarily, if they are to keep their position, be continually introducing new methods and ideas, to have the opportunity of selection from the most promising students in the country than to make a few hundreds a year from the fees of apprentices.

I am glad to find there has been a great change in this respect within the last few years, and that the practice of requiring premiums is far less general, at any rate in mechanical engineering works, than it was at the period of which I am speaking. Indeed, I was told only the other day that one of the largest University Engineering Schools in the country was now able to find places without premiums for practically all its graduates.

Though I am afraid any knowledge of engineering I ever possessed has long since evaporated, my short training for that profession has, I think, had a distinct influence on my work in physics and on the way I regard physical phenomena. I never feel contented nor comfortable with the representation of an effect by systems of equations, valuable as these are for many purposes, the stifled instincts of the engineer, for I suppose it is that, make me restless until I can imagine some kind of mechanical model which possesses properties analogous to those of the phenomenon under consideration.

The title of my address this evening, "The Relation of Pure Science to Engineering," is one in which the nomenclature requires perhaps some explanation. The distinction between Pure Science and Engineering is one, not of method but of aim. The methods employed by the Physicist and the qualities of mind called into play in his investigations, are to a very large extent the same as those used by the engineer in the higher and more pioneering branches of engineering. It is the aim that is different. The Physicist endeavours to discover new properties of matter, new physical phenomena, for the sake of extending his knowledge of nature and without any thought as to their utility or the possibility of their application to the service of man. Faraday, when he discovered electromagnetic-induction, was not thinking of the electric light, or electric traction or the foundation of a great industry, he was just trying to get to know something about electricity; and so it is with all great discoveries. The joy of discovering something new and true is so great that other things sink into insignificance. I do not suppose for a moment that the pleasure which Lord Rayleigh gets from having discovered Argon is at all diminished by the fact that Argon has not as yet received any commercial application.

It is not the business of the physicist in his researches to concern himself at all with their utility; this can very well take care of itself or be left to others to develop. It is a very striking feature in the history of science, that almost every advance in pure physics has been turned to account by the engineer, the manufacturer, or the doctor. To take an example. Could anything be, at first sight, more remote from practical application than the study of the passage of electricity through gases; beautiful and interesting though the phenomena with which it has to deal undoubtedly are, they seemed for long quite remote from any practical application. Yet it is to the study of these phenomena that we owe the discovery of Röntgen rays, which are now throughout the world used for the alleviation of human suffering. Again, the purely mathematical theory of the transmission of electrical waves along conductors, as developed by Mr. Heaviside, was the origin of Pupin's successful system of long-distance telephony. No one can foresee in its early stages the possibilities which may be latent in any scientific discovery. The story of the ugly duckling has had many illustrations in the history of the relation between applied Science and engineering.

Nothing could, I think, be more disastrous to the progress of engineering than that the workers in pure science should hamper themselves by considerations as to the utility of their work, or confine their attention to points which have an obvious practical application. With such limitations, details in existing processes might be improved, but those great advances which have revolutionised industries would be lacking. If this policy had been pursued in the past we should still be travelling by stage coaches, though, doubtless, these would have been greatly improved since the time of our ancestors.

Applied science is even more indebted to the pioneer who discovers and opens up new regions of thought than to the man who improves the cultivation of long-settled regions of known fertility. The province of applied science, of engineering, is to survey the facts known to science, and to select those which seem to have in them the possibilities of industrial application; to study and develop them from this point of view. This development, I should think, can generally best be done in laboratories or research workshops attached to works engaged in active trade. Here there are opportunities of testing the results on a commercial scale, here is available that technical knowledge of detail which often means the difference between success and failure, and here, too, are probably available greater supplies of money and greater incentives to success than are at the disposal of Government, municipal or university bodies. The success of works' laboratories in Germany and the United States, and to a growing extent in this country, is one of the most striking features in modern industrial development. The sums spent on these institutions are sufficient almost to take the breath away of one who has only been accustomed to the expenditure of a laboratory devoted to pure physics; but I have never heard that the firms who have established these laboratories regret their expenditure. Indeed, I have been told by some that they regard it as their most profitable investment, and certainly the balance sheets of the firms whose laboratories are on the most extensive scale do not suggest that they are ruining themselves for the cause of science.

A closer connection with pure science would, I think, be of the greatest service to engineering and commerce in this country. Great strides in this direction have been made in recent years, but we are, I think, still behind Germany in the importance we attach to pure science, and in the eagerness with which new discoveries are applied to industrial purposes. The case of the aniline dye industry has been made the text of many a sermon, but we have not even yet taken the lesson to heart, for it is easy to find instances which are quite parallel, and which have occurred within the last few months. Let me give you one, to judge from the number of "Thermos flasks" one meets with, and the prevalence of advertisements full of descriptions of their virtues, the manufacture of these flasks must constitute a large and, I should think, profitable business. I am told, however, that none of these flasks are made in England. Yet the Thermos flask is an English invention, it is nothing but what is known to Physicists as the "Dewar vessel," a

* Presidential Address before the Junior Institution of Engineers.

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double vessel where the inside is separated from the outside by a vacuum, which was invented by Sir James Dewar for the purpose of storing liquid air without too much evaporation, and was described by him some years ago; although the discovery was made and first published in England no English manufacturer took it up, but left it to their foreign rivals to make it the basis of an important trade.

One way in which the connection between Pure Science and Industry could be strengthened would be by closer relations between the workers in Science and Industry. Let me give an instance of what I mean. A Physicist or a chemist comes across some new fact which he thinks might conceivably have an application to industrial processes, he may not, however, be interested in that aspect of it, and even if he were he is very unlikely to have the appliances to work out the thing satisfactorily from the manufacturing point of view; if, however, he were in touch with the manufacturers and engineers he would know who were the people who were most likely to be interested in it and who possessed the best facilities for investigating it. He could then suggest to these that it may be worth looking into the thing in their laboratory, and probably in some cases valuable results would ensue. No doubt this does go on to some extent in this country at present, but I believe it prevails to a much greater extent in Germany than it does here.

The spirit I should like to see spread throughout British industry is the exact antithesis of that expressed by the saying: "Oh, that is very well in theory, but it does not work in practice." This saying is really a contradiction in terms, for if the theory is right and the practice is right the two must be consistent; and it should be the aim of workers in Pure and Applied Science to make them agree, unless they do something is wrong somewhere.

To unite and harmonise these two essential things, theory and practice should be the mission of Applied Science. I have mentioned some cases in which the practical application lagged far behind the theory, the converse is, however, quite as common; it very often happens that when a subject is applied to practical purposes and tried on what may be called an engineering scale, it develops far beyond the stage it has reached in the laboratory or in the portfolio of the mathematician. Practice, as in the case of aviation at the present time, outstrips theory, and progress has to be made by trying one thing after another until something is found which is successful. Multitudes of instances where this has occurred could be given; to take only two, there are many phenomena in wireless telegraphy which have not yet received any adequate explanation, and there are others which, though now understood, were not so until long after their existence had been discovered by those engaged in the practical development of that process. Again, from what I remember of the lectures on Chemistry to which I listened more than 30 years ago, I imagine that the sulphuric acid industry was in full vigour before chemists were agreed as to exactly what it was that did happen when that substance was being manufactured. These are, however, just the cases when research laboratories in connection with the works may render most efficient aid, and where investigations skilfully conduced by scientific workers acquainted with the results met with in practice may lead to a much more rapid development of the subject and the saving of large sums of money. The practical man in this case is just in the position of the physicist when he meets with a new phenomenon for which at first he can see no explanation; the same qualities of mind are required, and though the scale of the experiments may be different, the general method of attack will be much the same in the two cases. It is the object of Applied Science to keep Theory and Practice at the same level, by raising the one underneath, not by pulling down the other. Theory and Practice do better work when they are driven abreast than in Tandem.

The more intimate the relation between theory and practice, between the workers in pure science and those engaged in the application of science to the arts, the greater will be the opportunity of deepening the faith in science of the practical man and the reliance he places on its conclusions and anticipations. For in the case of science, familiarity breeds confidence and not contempt. I admit that this confidence does not come at once. For example, when one first begins to do practical work in the laboratory and to verify by experiments the principles taught in the text books, I think the impression one derives from one's first attempt at practical work is that there is a great deal of truth in the saying of a former tutor of Trinity College, that the principle of the constancy of the laws of Nature was never discovered in a Laboratory. A cynic, too, has remarked that if you wish to believe in the laws of Nature never try an experiment. These, however, are only the feelings of the novice, and with greater experience and knowledge of practical work they are replaced by a continually increasing confidence in the conclusions we draw by abstract reasoning from the laws of Nature. This confidence in the results obtained by scientific reasoning should, I imagine, be an almost indispensable qualification for the engineer who wishes to open new ground. One of the most conspicuous examples of faith in science I am acquainted with, is that of the discovery of artificial indigo, it is said that the Badische Company spent twenty years and nearly a million sterling working at the solution of this problem before they succeeded and before they got any pecuniary return. From the few opportunities I have had of seeing anything of manufacturing processes in different countries, I have got the impression that faith in the results of pure science is more robust in Germany and the United States than in this country; that here we cultivate more exclusively things which ripen quickly and yield an immediate return upon the capital invested, and are inclined to turn aside from projects which, though more profitable in the long run, would, so to speak, take a long time before they came into bearing.

It is not that in England there is any lack of recognition of the importance of science or reluctance to use it among the leaders of applied science, we are fortunate in this country to possess many conspicuous examples of the combination of pure and applied science. It is rather that what I may call the scientific spirit has not diffused through and influenced the bulk of our industries to the extent it has done in one or two other countries. We have never lacked pioneers who have led the way in the application of science to industry; we have had men who, like Rankin, have made engineering a science itself, but it cannot, I think, be maintained that Science plays as large a part in engineering and industry on a whole here as it does in Germany. How is this to be altered? No doubt a most potent influence in this direction will come when it is realised more fully than it is at present that the union of science and industry pays. I never realised myself how prolific this union was so fully as I did the other day, when I was travelling from Cologne to Berlin. After leaving Cologne we were for nearly two hours travelling through an almost uninterrupted succession of factories and works of almost every kind, the majority of them showing every indication of having been built within the last few years. The objection to trusting in this influence is that under it you do not begin to take a certain course until after your rivals have proved it is the right one, and they get a very long start. Another reason for the comparative neglect of pure science in engineering, I think, is that the training in that subject given in our engineering and technical colleges is not that best adapted to develop any great interest or enthusiasm for it. Economy of time is so important that attention is paid only to those parts of science which have direct application to present-day practice in engineering or other industries. The result is that the student gets his pure science in snippets, and that it seems to him a disconnected bundle of facts for which he is quite unable to get up any enthusiasm or feel much interest. This is bad in every subject, its results are especially conspicuous in mathematics. The language of mathematics should be as familiar to the engineer as his mother tongue; his mathematics should be as a part of himself, and he should be able to use them with the confidence with which a good workman uses his tools. If, however, the student's training in mathematics or pure science is confined to those parts of the subject which are of direct practical utility, he will never acquire this confidence. He may be quite able to follow the mathematics he meets with in the course of his reading, but for him mathematics will never be a formidable weapon with which to attack new problems. If you cut away all the parts of a science except those which seem to have immediate practical application, you rob it of its

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beauty and vigour, and make it exceedingly uninteresting. All work and no play makes Jack a dull boy; all the useful parts of a science and nothing else make a desperately dull subject.

It will, I know, be urged that the curriculum for engineering students is already so overloaded that it is impossible to find time for a fuller study of science and mathematics. I acknowledge that at present this is true. But it is only true because that curriculum is founded on the truly British idea that our boys are not expected to learn anything at school. Most of the work in the courses for students in their first year, and some of that in the second, in all the engineering schools with which I am acquainted, is of a kind that a boy might well be expected to have done at school. There is no reason, from the nature of things, why a boy of eighteen of the mental calibre which would justify him on becoming an engineer, should not have a good working knowledge of the calculus and the elementary parts of differential equations, and have read a considerable portion of dynamics. This could, I am convinced, be done without undue specialisation and without depriving the boy of that literary training which is essential if he is to keep his sympathies wide and his mind receptive. If students entered our engineering schools prepared up to this standard, then changes could be made which would widen their interests in pure science and tighten their hold upon it.

Though I regret the predominance of classics in our public schools, I should regret still more any system which allowed boys to restrict their studies entirely to scientific subjects, in fact, to any system which involved premature specialisation. A large part of the success of an engineer depends upon his power of impressing and influencing the men with whom he is brought into contact. Now, of all the various kinds of apparatus with which one has to work, man is by far the most sensitive, the most likely to get out of order, the most difficult from which to get good results. The education of the engineer ought then to be framed so as to develop those qualities which make him, in the best sense of the word, a man of the world; one easy to get on with; one with whom it is pleasant to have to deal. To make him, in fact, a man with wide sympathies and interests. These qualities are, I think, much more likely to develop by a training which includes a considerable study of literature than one which is severely restricted to scientific or technical subjects.

What seems to me by far the most important thing to aim at in the school training of the boy who is to be an engineer is not that he should be taught a number of facts about the various branches of science; that is a matter of slight importance at this stage of his career. What is important is that he should be trained in the scientific habit of mind, which, after all, is nothing but organised and directed common sense. The training that is wanted is one that will train the boy to think about things—one that will train him so that he will get the whole weight of his mind on to the problem he is tackling. If he has got this power then it is not, I think, a matter of primary importance as to what may have been the nature of the studies by which he has attained it. A boy who has this power is, I think, far more likely to make a good engineer, even though his training has been wholly classical, than one without it, even though he has studied the whole gamut of the sciences. I do not wish to imply by this for a moment that I think that this power is best got by a predominatingly classical curriculum, in my opinion is not the case.

Another point to which I attach great importance in the early training of the engineer and also of the physicist, is that he should have a good drilling in experimental mechanics, and make many simple experiments on the properties of body in motion. I should encourage him to have a little workshop of his own, not so much that he might acquire skill in the use of tools as that by familiarity with matter in motion and machines, he might cultivate the "mechanical instinct." By that I mean the power which some possess of feeling instinctively without conscious reasoning in their bones, so to speak, what is the accurate solution of some mechanical problem. This faculty, which is obviously one of great importance to engineers and physicists alike, is possessed by some men to an astounding degree. It was said by Clerk Maxwell's contemporaries at Cambridge, that he could not think wrongly about mechanical problems even if he tried to do so. I have heard it said about a great engineer that you never felt any doubt about his conclusions until he began to give his reasons for them. This instinct, which all great engineers possess, can, I do not say be created—indeed I think it cannot—but it can at any rate be developed by long familiarity with mechanical studies. Finally, I would conclude by quoting the words of one who can speak with far greater authority than I can on any question relating to the training of engineers, who is at the head of one of the greatest engineering industries in the world, I mean Sir Andrew Noble. "Do not," he said, "be too utilitarian: do not narrow the search for knowledge down to a search for utilitarian knowledge for knowledge that you think will pay . . . above all things, pursue knowledge."

POPULARISING ELECTRICITY.

A very interesting experiment which has just come to so successful a close that it is to be repeated at frequent intervals in the future, is recorded in the current issue of the San Francisco "Journal of Electricity." The problem was, How can an electric company expect to establish friendly relations with its patrons by tact and courtesy when the public knows so little about what they are buying? The first essential is to educate the layman, to introduce scientific terms into the vernacular so that the buyer and seller may speak in the same language. That the layman is eager to learn is attested by the increased demand for books and articles on popular science. How to educate him? Well, during the past summer a number of electrical manufacturers employed a college professor to roam around their works, just as does a "business doctor" who is sometimes called in to diagnose and prescribe for business failure. But this professor's mission was somewhat different. He simply talked with the men, encouraged them to ask questions and explained in simple language the scientific principles underlying the work they were doing. The companies considered the investment so good that they plan to repeat it at frequent intervals in the future. This professor possessed the rare faculty of popularizing science, of making technical matters clear to the common people. He taught the rudiments of a new language. True it is that they learn only a sort of pidgin English, a makeshift that has little scientific use insomuch as what is gained by generalities is lost in definiteness. We do not use a 13 inch gun to shoot rabbits, nor is it necessary that the layman be equipped with the ammunition of the scientist to gain a general knowledge of electricity. But if he can be supplied with an elementary knowledge he can be brought to a sympathetic appreciation of the wonders of electricity and if he so desires may even use it as a skeleton key to unlock the more intricate subjects. "All employees of electrical companies," adds the writer, "should be well informed regarding the elementary principles of electricity and be ready at all times to explain them to consumers. A small pamphlet explaining the meaning of a watt, a volt and an ampere and showing how they are measured, as well as giving directions for reading meters would be a good investment if given general distribution. Illustrated lectures and simple experiments at schools, church, clubs and other organizations, sow the seed on confidence broadcast, and not only dispel the prejudice due to ignorance but also establish the desired amicable relations with the public."

"EXCELLO."

A little publication eminently calculated to call attention to the advantages of improved arc lamps for certain phases of illumination is the little pamphlet entitled, "Why the Excello Excels," just issued by the Union Electric Company, Limited. It tells in easily-understood language the difference between enclosed and flame arc lamps, and, of course, the special merits of the "Excello" type. The description is helped out by some very striking illustrations. It should be stated that the pamphlet will be sent out in quantities to any contractor or dealer who writes for them.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

BARNES.—The District Council have decided to increase their electricity works reserve fund (now amounting to £3,000), "as and when convenient," until such fund shall amount to 10 per cent. of the aggregate capital expenditure on the undertaking.

DONAGHADEE.—The Urban Council have finally decided to apply for a Provisional Order under the Eleteric Lighting Acts. The scheme is to be entrusted to Messrs. Wilkins and Burden, electrical engineers, of Dublin.

DOVER.—Chain stokers are to be installed at the Corporation electricity works at a cost of £550, and a loan for this amount, repayable in 10 years, has been sanctioned by the Local Government Board, without enquiry. It is proposed to extend the supply mains to River. This could be done at a cost of £200, by taking the wire overhead on the tramway standards as far as River and then underground.

HOLMFIRTH.—The Yorkshire Electric Power Company, Ltd., have made an offer to the District Council to extend their supply mains to this district. The offer is being considered.

LEEDS.—The Electricity Committee have issued a financial statement for the half-year ending September 30. This, of course, covers the lightest part of the year, and the deficit shown, after allowing £16,000 for redemption of debts, is £8,979 (£3,342 less than last year), but the complete twelve-months is expected to show a good net profit. The revenue for the half-year shows an increase of £3,176, while the expenditure shows a slow decrease. There is still a slight fall in the number of units consumed for private lighting, but apparently the chief effect of the filament lamps has now been felt, and an upward tendency may be expected. There was an increased demand for power, partly due to new motor installations and partly to better trade.

LEEK.—At the recommendation of the Lighting Committee the Council adopted the following resolutions: (1) That an additional engine and dynamo be obtained for the electricity works, provided that the price charged for current supplied to power consumers using more than 16,000 units per half-year be increased to 1·35d., with an allowance of one-tenth to one-twentieth of a penny, as the cost of production decreases, with a minimum charge of 1·125d. per unit; (2) that the application from Messrs. Brough, Nicholson, and Hall, Ltd., for an additional supply of electricity be granted subjected to a guarantee that they will consume not less than 630,000 units during the next three years, at the prices already named; (3) that application be made to the Local Government Board for sanction to a loan of £4,000 by the Council for the purchase of a 300 horse-power Deisel oil engine at the Electricity Works.

PATELEY BRIDGE.—Messrs. Crampton and Company, Chelmsford, have given statutory notice of their intention to apply for a Provisional Order for the public lighting of the district.

SLOUGH.—The Uxbridge and District Supply Undertaking are applying for a Provisional Order for the lighting of this district.

WORCESTER.—The Electricity Committee recommended that their canvasser should be allowed to take orders for motors and other electricity consuming apparatus, and to pass these on to local traders, or to manufacturers if necessary, and to charge 10 per cent. for so doing. This was strongly opposed and rejected by the Council. It was explained that the main object was to extend the use of current; the commission would go towards defraying the expenses of the canvassers. One of the councillors made the enlightened suggestion that the canvasser's salary should be saved by getting rid of him.

OVERSEAS.

COBALT, ONTARIO.—Work has been started on the development of a hydro-electric plant on the Mattagami River at Sandy Falls, in the Porcupine district, six miles from the Timmins Mine. Three thousand horsepower in generators has been ordered from the Canadian Westinghouse Company, Limited, and turbines of like capacity from the S. Morgan-Smith Company, of New York. This plant will be in operation by June 1, 1911. Current will be generated at a pressure of 12,000 volts and a frequency of 25 cycles per second.

DAKAR, SENEGAL.—The Government have authorised the installation of an electric power plant.

TORONTO.—The directorate of the Canadian National Exhibition to be held at Toronto have adopted a report recommending the expenditure of a sum of 80,000 dols. (about £16,400) in the electrical wiring of the exhibition grounds and buildings.

WINNIPEG.—The first instalment of the City's 60,000 h.p. electrical installation will be ready by June next, and efforts are to be made to make the capital of Manitoba a big manufacturing centre, by attracting British and American manufacturers, by offering cheap power and transport facilities.

TRACTION.

HOME.

BELFAST.—Something like finality has been reached in the preliminary stages of the Corporation Tramways extension. It has been decided that the M'Art's Fort Tramway scheme shall not be included in the Omnibus Bill to be introduced in next Parliament. There was strenuous opposition to this postponement.

COWDENBEATH.—The branch line of the Dunfermline and District Tramways between Cowdenbeath and Kelty having been inspected by Colonel von Donop, of the Board of Trade, and everything found satisfactory, the branch is now opened for traffic.

DARTFORD.—The electric tramway system is to be extended from Horn's Cross to Swanscombe in order to connect with the Gravesend cars. It will thus be possible in the future to journey from London to Gravesend by car, a distance of 22 miles, through some of the finest scenery in Kent.

DUNDEE.—A proposal is before the Corporation to extend the tramway from Blackness-road to Glamis-road.

LONDON.—Electric tramways are to be brought over the proposed St. Paul's Bridge as far as the corner of Cheapside. Cars will enter a subway on the south side of Cannon-street and pass along the line now occupied by the block of buildings between the eastern side of St. Paul's Churchyard and Old Change, which is to be pulled down at a cost of £300,000, the expense being divided between the City Corporation and the L.C.C.

OVERSEAS.

MADRID.—An application has been made to the Dirección General de Obras Publicas, Ministerio de Fomento, by the Compañía General de Tranvais de Valencia, for a concession for the construction and working of an electric tramway from Catarroja to Silla (Valencia). Eight tramcars with motors and 16 without motors (trailers) will be required for the working of the line.

VARESE.—The Station Department of Public Works have granted a concession to the Società Anonima Varese per Imprese Elettriche for the construction and working of an electric tramway from Varese to Masnago. The distance to be covered is slightly over two miles.

COMPANIES' MEETINGS AND REPORTS.

RENARD ROAD AND RAIL TRANSPORT.

The report of the Renard Road and Rail Transport Corporation, Limited, states that the accounts for the 14 months to December 31, 1909, after placing £3,000 to reserve for bad and doubtful debts and writing off £6,028 for depreciation, etc., show a loss of £16,803, increasing the debit balance of profit and loss account to £19,193.

PROVINCIAL TRAMWAYS COMPANY.

The 53rd ordinary general meeting was held at Moorgate-street-chambers, Mr. Andrew Beattie presiding. In moving the adoption of the report, the chairman said that they had had rather a good year in spite of the unfavourable weather in July and August. The net profit amounted to £33,454, as compared with £33,060 in the previous 12 months. With regard to the expenditure, he remarked that there seemed to be a growing desire on the part of local authorities to increase the valuation of industrial undertakings, and, consequently, the rates and taxes payable. He feared that, unless some curb were applied to that propensity on the part of those who occupied representative positions, the industry of the country would be taxed to such an extent as to interfere with the welfare of enterprise generally. During the year the ordinary shares were reduced from £10 to £5 each, and converted into five £1 shares. The directors recommended a final distribution of 9d. per share, making, with the interim payment, 1s. 5d. per share for the period under review, being equivalent to a dividend of 7s. 1d. on each old £10 share. Mr. Oke seconded the motion, which was adopted. A resolution was also passed authorizing the Portsmouth Street Tramways Company—one of the company's undertakings—to apply for a Light Railway Order or a Provisional Order to extend the tramways at Gosport to Lee-on-the-Solent.

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EAST INDIA TRAMWAYS.

The report of the East India Tramways Company, Limited, states that the gross receipts and payments for the year to July 31 amounted to £12,442 and £9,559 respectively, as against £11,163 and £8,604 respectively for the previous year, leaving (after placing £500 to suspense account) a balance of profit of £2,382, as against £1,558 in 1909. The directors recommend a full dividend at the rate of 5 per cent. on the Ordinary shares, and at the rate of 1¼ per cent. on the Deferred shares, leaving a balance to be carried forward of £176, which includes £120 from last year. In last year's report reference was made to the trial that was then being made of motor-driven cars. These trials have been so far successful that the directors have determined to gradually supersede all the horse-cars by motors. It will be remembered that the introduction of a more powerful form of traction was necessitated through the building by the Karachi Port Trust of an over-bridge with heavy gradients. Towards the extra expense which this will cause the company the Trust, after long negotiations, have contributed £9,500, and this amount has been put to reserve account. Although during the year the motor-cars were to a great extent in an experimental stage, and many alterations and improvements in detail were found necessary, 14,702 miles were run by motor traction, at a running cost of about 2¾d. per car-mile, as against 3½d. per mile horse traction.

COMPANIES REGISTERED.

Electric Water Heaters (Limited), 168, St. Vincent-street, Glasgow.—To carry on the business of makers and installers of water heating apparatus, etc. Capital, £2,000, in £1 shares. The public are not invited to subscribe.

Mattagami River Falls Syndicate, Ltd.—£1,000, in £1 shares. Business: Electric light, heat, water and electric power company in all its branches. Minimum cash subscription, £7.

English Electrical Company, Ltd., Nottingham.—Capital of £5,000, in £1 shares, to carry on the business of manufacturers of and dealers in electrical, incandescent filament lamps, or other illuminating apparatus, electrical engineers and contractors, suppliers of electricity, etc., and to adopt an agreement with the Midland Machine Trust, Ltd. The subscribers are:—E. Jardine, M.P., The Park, Nottingham; D. J. Jardine, The Park, Nottingham, machine builder; and J. McConnell, 6, Southey-street, Nottingham, warehouseman. Private company.

Salford Electrical Instruments.—(£1) (10,000 Preferred). To carry on the business of manufacturers of and dealers in electrical measuring instruments, meters, wires, cables, and other apparatus, etc., as formerly carried on by the General Electric Company, Ltd., of 71, Queen Victoria-street, E.C., at Bow-street Works, Adelphi, Salford, Lancashire. Private. 67, Queen Victoria-street, E.C.

LITERARY NOTES.

Messrs. E. and F. N. Spon, Ltd., announce that their "Architect's and Builder's Pocket Price Book," 1911 edition, is now in the press and will be ready for publication in the early part of December. The book has been divided into two sections:—"Memoranda and Tables," price 2s. 6d. net; "Prices and Diary," price 2s. 6d. net. The diary, showing a whole week at an opening, is a new feature of the "Prices and Diary" section, and is printed on India paper, so that each section now exhibits that pleasant flexibility and thinness which was so attractive a feature of the 1909 issue. The whole has been subjected to a thorough revision, the prices in particular having been most carefully brought up to date. To distinguish the two parts, the "Memoranda and Tables" will be bound in a striking red colour, and the "Prices and Diary" will retain the green colour, so familiar to thousands of buyers of the previous issues. Both sections are still real pocket books, and contain a vast mass of information in a very handy and portable form.

ELECTRICITY FOR DOMESTIC PURPOSES AT GLASGOW.

The Electricity Committee of Glasgow Corporation have had before them a report by Mr. W. W. Lackie, chief engineer of the Electricity Department, on the subject of supplying domestic consumers with energy for cooking, heating, and other domestic uses at a lower rate than the charge for lighting, the energy to be taken from the existing lighting circuits, the cost of separate wiring thus being avoided. He says there is a growing need for facilitating the use of electrical energy for other than lighting purposes. In addition to its application for heating, cooking, etc., there are many electrical appliances which would come into considerable use if consumers could be induced to try them experimentally. He referred to radiators, electric irons, vacuum cleaners, etc. It was felt that many consumers, particularly domestic, would use these appliances if they could get the energy thus consumed at a rate lower than the lighting charge, and without being called upon to undergo the inconvenience and relatively large outlay of installing separate wiring, which was necessary under present conditions. He was of opinion that there would be no difficulty in meeting such cases by a method of charging which was an adaptation of the maximum demand system. From an examination of a large number of accounts of domestic consumers covering the past three years he found that these accounts were practically stable from year to year, and even in the corresponding two-monthly account periods of different years. The examination showed that the maximum demand quantity of domestic consumers averaged an 800 hours' use of the maximum demand per annum. The present charge to domestic consumers was a flat rate of 3d. per unit, and he suggested that they charge a maximum demand rate of 3d. per unit for 800 hours' use of the maximum demand, all current consumed over this quantity to be charged at 1d. per unit. Further, he proposed that the initial charge for the first 800 hours' use of the maximum demand should be on the principle of a proportionate number of 3d. units in each two-monthly account period, all the units consumed over this fixed quantity in the period being charged at 1d. This would let the consumer see in every account that as a result of using energy for other than lighting purposes so many units were charged at 1d. This system of charging would increase the output and add to the revenue without adding to the expenditure in the way of branch mains, fuses, meters, and meter readers, or expense in administration. He believed it would lead to a considerable use of electricity for intermittent heating in spring, summer, and autumn, when fires were generally off and only occasional heating was required. This was the time of the year when they had a considerable amount of plant standing idle, earning no revenue, so that heating units at 1d. would be profitable revenue. Since the Smoke Abatement Exhibition he had had numerous applications for a supply of current at power rates from domestic consumers for the heating of electric irons. In American cities a considerable revenue was derived from this source, and he saw no reason why they should not have the same in Glasgow.

The committee recommend that these proposals be given effect to as from June 1 last.

PERSONAL.

Mr. C. E. D. Greenhalgh, late assistant to the Malvern Urban District Council, was some few weeks ago appointed Resident Electrical Engineer to the Rainhill Asylum, near Liverpool, and has now taken up his duties.

Mr. F. M. Long, of the Norwich Corporation Electricity Works, has succeeded Mr. Hardy as electrical engineer to the Cromer Council.

Mr. W. Perren Maycock, M.I.E.E., has been appointed lecturer on Electric Wiring and Wiring Calculations at the South-West London Polytechnic, Chelsea, S.W.

Mr. E. Lloyd Jones, who recently resigned the post of resident engineer of the West Ham Corporation Generating Station, Canning Town, in order to become a partner in the firm of Murry & Company, of 21, Walbrook, E.C., was entertained at a smoking concert by the staff and presented with a handsome clock.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 169, Fleet Street, London, E.C.

CONTRACTS.

URBAN DISTRICT COUNCIL OF WALTHAMSTOW.

ELECTRICITY DEPARTMENT.

The above COUNCIL invite TENDERS for the supply, Delivery, and erection of the ELECTRICITY WORKS, Priory-avenue, Walthamstow, of the undermentioned PLANT:—

Contract H:—One 1,000 kw. Mixed Pressure Turbine with Tandem Generators of 500 kw. each, complete with Surface Condenser and Pipework.

Copies of the General Conditions, Specification, Form of Tender, and Drawings can be obtained from Mr. G. R. Spurr, Electricity Works, Walthamstow, on depositing the sum of Two Pounds (£2), which amount will be returned on receipt of a *bona-fide* Tender, together with Specification, General Conditions and Drawings, and to the successful Tenderer on completion of the Contract.

Sealed Tenders, on the prescribed Form, endorsed "Tender for Contract H," must be delivered (by post only) to the under signed not later than 5 p.m. on FRIDAY, the 25th day of November, 1910.

The Council do not bind themselves to accept the lowest or any Tender.

C. SYDNEY WATSON,
Clerk to the Council.

Town Hall, Walthamstow,
November 3, 1910.

COUNTY BOROUGH OF WEST HAM.

EDUCATION COMMITTEE.

TO ELECTRICIANS.

The EDUCATION COMMITTEE of the County Borough of West Ham invite Tenders for the INSTALLING OF ELECTRIC LIGHT at SALWAY PLACE SCHOOLS, STRATFORD, E.

Contractors desiring to tender are requested to make written application to Mr. William Jacques, A.R.I.B.A., Architect to the Education Committee, 2, Fen-court, Fenchurch-street, E.C., for copies of Specifications, Conditions, and Forms of Tender.

Each application must be accompanied by a deposit of £1 (One Pound), to be returned to those who send a *bona-fide* Tender in the manner and at the time stipulated.

Sealed Tenders in the envelopes supplied must be delivered by Registered Post at the Education Department, 95, The Grove, Stratford, E., not later than 6 p.m. on MONDAY, November 28, 1910.

The Committee will not be bound to accept the lowest or any Tender.

The Contractor whose Tender is accepted and with whom a contract is entered into will be required to pay to the whole of his workmen such rate of wages and observe such hours of labour as are recognised by the Workmen's Trades Unions, and in force at the time of signing the contract. In the event of any breach of such agreement, the Council will enforce the penalty clause in its entirety.

By Order,
FRED. E. HILLEARY,
Town Clerk.

Education Department,
95, The Grove, Stratford, E.
November 11, 1910.

OSRAM·LAMPS

CITY OF BIRMINGHAM.

TRAMWAYS DEPARTMENT.

The TRAMWAYS COMMITTEE are prepared to receive Tenders for the supply, delivery and erection of 60 ELECTRIC TRAMWAY CARS.

A form of Tender, with Instructions, General Conditions, Specification and Drawings can be obtained on application to the undersigned at the Tramway Offices, County-buildings, 147, Corporation-street, Birmingham, on payment of £2, which will, after the Committee shall have come to a decision upon the Tenders received, but not before, be returned to the Tenderer, provided he shall have sent in a *bona fide* Tender.

Tenders must be enclosed in a sealed cover, addressed to the Chairman of the Tramways Committee, 147, Corporation-street, Birmingham, and endorsed in the left-hand corner, "Tender for Rolling Stock," and must be handed in not later than 10 a.m. on MONDAY, the 12th day of December, 1910.

The Committee do not bind themselves to accept the lowest or any Tender.

The Contractor will be required to pay not less than the standard rate of wages current in the district where the work is done.

ALFRED BAKER,
General Manager.

County Buildings, 147, Corporation-street, Birmingham.

CONTRACTS OPEN.

HOME.

BIRMINGHAM.—The Corporation invite tenders for the supply and erection of 60 electric tramway cars. For particulars, apply to General Manager, Tramways Department. December 12.

LONDON, FOR CALCUTTA.—The Calcutta Electric Supply Corporation, Ltd., invite tenders for the supply of overhead electric and hand travelling cranes, with rails, conductors, motors, etc. (Specification No. 9). Particulars from The Secretary, Calcutta Electric Supply Corporation, Ltd., Salisbury-house, London-wall, E.C. December 1.

LONDON.—The London County Council invite tenders for the overhead electrical equipment on the trolley system required in connection with the construction of the new tramways, approximately 1 mile in length, between Putney-bridge and Wandsworth High-street. Specifications, bills of quantities, form of tender, etc., from the Department of the Clerk of the Council, County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of £2. December 6.

WALTHAMSTOW.—The District Council invite tenders for one 1,000 kw. mixed pressure turbine with tandem generators of 500 kw. each, complete with surface condenser and pipe work. Specification, etc., obtained (deposit £2), Mr. G. R. Spurr, Electricity Works, Walthamstow. November 25.

OVERSEAS.

AUSTRALIA.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on December 6, for the supply of (1) cable testing instruments (Schedule No. 336) and (2) 6,000 jacks (Schedule No. 385). Tenders will be received at the office of the Deputy Postmaster-General, Adelaide, up to noon on December 29, for the supply of (1) battery and line material, and telegraph and telephone instruments (Schedule No. 147), and (2) telephone cable (Schedule No. 149). Tenders will be received at the office of the Deputy Postmaster-General, Sydney, up to 2.30 p.m. on January 4, 1911, for the supply of 3 multiple-magnete switchboards (Schedule No. 45). A deposit will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to each of the above contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

BRISBANE.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up to noon on January 4, 1911,

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for the supply of (1) poles and ironwork (Schedule No. 141), and (2) 17 magneto switchboards (Schedule No. 142). A deposit will be required with each tender. Local representation is necessary. January 4.

CONSTANTINOPLE (Extension of Time).—The Municipality invite tenders for the construction and working of electric tramways in Constantinople and suburbs. Extension from November 10 to December 20.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham House, Old Broad-street, E.C., and Central House, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a *bona-fide* tender.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 5¼ miles of lead-covered, paper-insulated telephone cable (Schedule No. 407). A deposit will be required with each tender. Local representation is necessary.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 200 contacts, plug seat, and 2,350 condensers (Schedule No. 402). A deposit will be required with each tender. Local representation is necessary. January 10.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

WINNIPEG.—With regard to the call for tenders, to be received up to 11 a.m. on December 1, by the Board of Control, Winnipeg, for the supply of poles and line supplies for the city electrical distribution system, the Commercial Intelligence Branch of the Board of Trade have now received a copy of the specification in this connection. This may be seen by British firms at the offices of the Branch, 73, Basinghall-street, London, E.C.

TENDERS ACCEPTED.

ATHERTON, LANCS.—For the Electricity Committee: 1,100 yards of cable, Callender's Cable and Construction Company; two single-phase oil-cooled transformers, British Electric Transformer Company.

FARNWORTH.—Electric installation at New Library for the Town Council: A. S. Dewhurst & Company, Manchester.

FAVERSHAM.—Picture palace, electrical installation: H. S. Fett & Company—£73 10s.

LONDON.—The British Westinghouse Electric and Manufacturing Company's tender of £6,490 for the provision of controllers, etc., for the London County Council tram-cars has been accepted.

LONDON COUNTY COUNCIL.—Asbestos tape covering for electric tramway cables: Johnson & Phillips, Charlton, Kent—£2,185.

NUNEATON.—Electric cable for the Town Council: W. T. Glover & Company, Trafford-park, Manchester.

READING.—Electric light fittings for county buildings: Strode, Osnaburgh-street, London, N.W.—£325; departmental telephones for Berkshire County Council: Hunkes & Son, Reading—£210.

SUNDERLAND.—For the Town Council: Meters, British Westinghouse Electric Manufacturing Company; cable, Trafford Park, Manchester, British Insulated and Helsby Cable Company, Ltd.

WATFORD.—Watford U.D.C.: Supply of transformers for 12 months, British Westinghouse Electric and Manufacturing Company, Trafford Park, Manchester.

WEST HAM: For the Town Council: Twelve new tram-cars, Dick, Kerr & Company; electrical equipment, Hurst Nelson & Company, bodies and trucks.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ABERYSTWITH: Mr. J. Ballinger, librarian. Erection of sections of the National Library.

BARNSLEY: Borough Engineer. Public Baths.

BOURNEMOUTH: H. E. Hawker, architect, St. Peter's-chambers, Bournemouth. Re-building of Victoria Hotel.

BUXTON: G. H. Widdows, architect, St. Mary's-gate, Derby. Alterations to Old Wye House.

FOLESHILL: A. E. Newey, Union Offices, Foleshill. Children's Home.

HEADINGLEY: S. D. Kitson, architect, Vicar-lane, Leeds. Two hotels for men at the City of Leeds Training College, Beckett's Park.

LYMM: H. Beswick, architect, Newgate-street, Chester. Additions to Grammar School.

MAIDSTONE: Kent County Architect. County offices, to cost about £50,000.

NOTTINGHAM: A. Marshall, architect, King-street, Nottingham. Infirmary.

ROCHESTER: J. W. Nash, architect, 237, High-street, Rochester. Two shops and dwelling houses.

SOUTHEND: Col. Johnson, C.B., Bank-chambers, Chelmsford. Drill Hall.

SWANSEA: Borough Estate Agent, 3 Prospect-place, Swansea. 103 houses.

TADCASTER: H. M. Driver, sanitary surveyor, Garforth, near Leeds. Corrugated iron administrative block at Tadcaster Infectious Diseases Hospital.

TRURO: A. J. Cornelius, architect, Truro. Mill.

OPENINGS FOR TRADE.

Wiring, Fittings, Accessories, etc.

Constructional and other work will shortly be carried out by the following firms. The amount mentioned is the contract price in each case.

Messrs. Cole & Sons, Milford Haven: Council School additions—£400.

H. Davies, Bargoed: Alterations to Bank—£700.

G. Elms, Newbury, Berks: Alterations to Church School, Hungerford, for cookery centre—£226.

H. H. Garlick, Moseley, Rugby: Police Court for Market Harborough—£4,209.

F. Gibson, Atherton-street, Durham: Small-pox hospital—£683.

Maple & Company, Tottenham Court-road: Laundry, cookery and laboratory, Romford—£384 17s.

Sturgess Bros.: School, Shipton Bellinger, Andover—£1,650.

R. Wilkins & Sons, Bristol: Erection and also extensions, electric theatres, Bristol—£1,250.

J. A. Milestone, Belvedere-road, Liscard: Nurses' Homes alterations and additions at Birkenhead—£2,818.

NOTES.

Enterprising Brighton Firm.

An interesting little ceremony took place at Royal Pavilion, Brighton, on Saturday, when Messrs. Page and Miles, Ltd., electrical contractors, of Western-road, Brighton, and of Hove and Worthing, held a staff dinner, in honour of the firm attaining their "majority." In that comparatively short space of time a splendid business has been built up, with ramifications all over the South Coast. Indeed, these contractors are known and respected for their enterprise and good work far outside their own district. As Mr. J. W. Penfold, the chairman, and Messrs. Page and Miles, said, this was largely due to the fact that masters and men had been absolutely loyal to one another. Their interests were really mutual. The pleasing harmony that prevailed spoke eloquently of this feeling.

Electricity Lectures.

Messrs. Siemens Brothers Dynamo Works, Ltd., have issued a revised list of their lantern slides, depicting various phases of electrical industry and different types of machines. These slides are very fine and are invaluable as the basis of many semi-business, semi-popular lectures suitable for all kinds of meetings during the long winter nights. The list should be in the hands of everybody interested in the development of the electrical industry.

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.,
Sculcoates,
HULL.

Electric Hoists and Lighting Magnets.

The General Electric Company, Ltd., are now the sole selling agents of the Witton-Kramer specialities, and they have issued a fine series of illustrated price lists dealing with these. The specialities include electric lifting magnets, and a large variety of patterns of electric hoists, now so largely used in the equipment of big factories and businesses of all kinds. The trolley-hoists have a very wide application, and should be brought to the notice of business people by enterprising electrical contractors, who, for this reason, should procure and file copies of these lists. Another interesting leaflet deals with portable tool equipments, including drills, boiler tube cleaners, grinding and polishing motors, etc.

Newport Technical Institute.

We reproduce here a photograph of the main entrance hall and corridors in which "Tantalum" holophane arcs and holophane spheres are installed. "Tantalum" arcs will doubtless have come before the notice of our readers previously, and we need not therefore go into details as to their construction. However, holophane glassware plays a very important part in their construction and they are intended to supersede the ordinary arc lamp for interior lighting purposes. The even illumination effect obtained by these fittings closely resembles the light from an inverted arc lamp, whilst at the same time it is not accompanied by the unsteadiness and flickering to which an arc lamp

is subjected. It is therefore not surprising to find that those responsible for the up-to-date installation of Newport have installed them in the corridors and also in the art class rooms, where it is desired to eliminate shadows and to discern colours at their true value.

We may add that this is only one of the many installations which are being carried out by Messrs. Siemens Brothers Dynamo Works, Limited, Tyssen-street, Dalston, London, N.E., who specialise in this particular type of fitting, and can submit very promptly numerous designs of holophane fittings, which are equally effective.

Light Dimmers.

Messrs. Donovan and Company, electrical manufacturers and suppliers, Birmingham, send us a well-compiled illustrated circular (No. 68), giving particulars of the "Donovan Patent Dimmers." They have been making these electric light dimmers for some years, and the fact that this system of dimming metallic filament lamps is coming into use in places such as sick wards, sick rooms, churches etc., is worthy of note by all contractors. One of the great features of this dimmer is that no blacklead or graphite is used in its manufacture and the element is practically indestructible and non-corrodible. Some of these dimmers have now been in use over five years, and are still working satisfactorily. The manufacturers recently immersed one of their 5135 dimmers in water and left it in water for 48 hours, then took it out and connected it up, and in less than three minutes it was doing its full duty as a dimmer. It is none the worse for the experience, the water having no effect on any part of the dimmer. This was certainly a severe and convincing test.

DIARY.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, Imperial Institute-road, South Kensington, at 5 p.m., Dr. A. Russell, on "The Electric Stress at which Ionisation begins in Air."

SATURDAY, NOVEMBER 26.

JUNIOR INSTITUTION OF ENGINEERS.—At 2.30 p.m. visit Messrs. David Kirkaldy and Son's testing and experimental works, 99, Southwark-street, London, S.E.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—At the St. Bride Institute, Fleet-street. At 7.30. Dance.

MONDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at the Society's Rooms, Adelphi, W.C., at 8 p.m., Mr. C. R. Darling, on "Industrial Pyrometry" (Cantor Lecture No. II.).

TUESDAY, NOVEMBER 29.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Students' Section).—At the School of Technology, at 7.30 p.m., Mr. H. A. Carney, on "What's Wrong with the Electrical Industry, and How to Put it Right—on Paper."

WEDNESDAY, NOVEMBER 30.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section).—In the Lecture Theatre of the Institution, at 7.45 p.m., Mr. J. C. Rennie, on "Tramway Brakes and Brake Gear."

WEDNESDAY, DECEMBER 7.

ELECTRICAL COMMITTEE.—In the Lecture Theatre of the Institution of Electrical Engineers, at 8 p.m., Conference, open to all members of the electrical industry, on the advisability of undertakers under the Electric Lighting Acts being empowered to wire premises and to supply electrical appliances. Cards from Mr. R. B. Matthews, Bank Buildings, Kingsway, W.C.

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PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

Electric Motor Car Accessories.

One of the most interesting features at the Motor Show held recently at Olympia were the dynamos for generating electric light, electric lamps, and accessories in connection with motor cars. Quite a new field here presents itself to the electrical manufacturer, merchant and supply departments in studying the requirements of the motorist. The advantage of touching, if not a button, then a switch, to "light up," while one's car is running, instead of having to pull up and light matches in a strong head wind, need not be dwelt upon here. The advantage of having a dynamo for feeding electricity into the battery, thus getting over the difficulty sometimes experienced in connection with accumulators will be at once appreciated by those acquainted with car lighting. By the new method the dynamo feeds electricity into the battery, and therefore the accumulators never run down. Some particulars of the various novelties shown at Olympia will no doubt interest our readers.

In conection with motor car lighting, the Leitner variable speed type dynamo claims attention from the fact that it has been in commercial use for car lighting for over five years. The concessionaires of the Leitner system, viz., The Rotax Motor Company, command attention to the

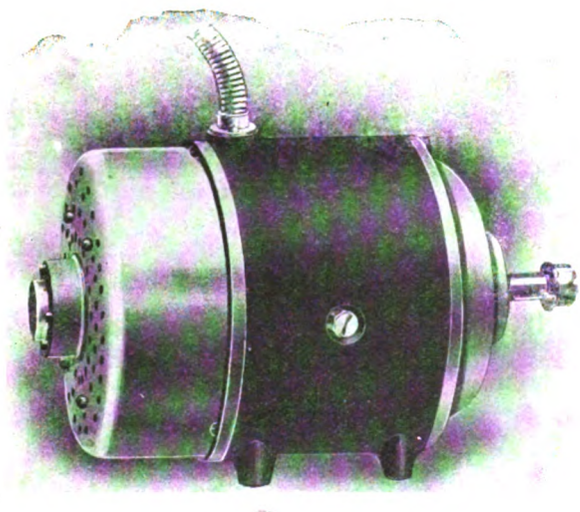

FIG. 1.—LEITNER VARIABLE SPEED DYNAMO.

following points, among others :—That the battery required in conjunction with a dynamo for car lighting should be comparatively small, as the dynamo mostly does the work. For such times, however, as the dynamo is not revolving—when the engine is stopped—or when it is revolving very slowly, the whole of the lighting load is thrown upon the battery, which latter is then discharging at a fairly high rate. Consequently, although cells are required of no larger dimensions than the usual ignition type, it is essential that the plates are suited for heavy discharges. The usual "pasted" positive plate is not suitable, and a "Planté" type plate should be substituted. In this type of positive plate there is no paste, the active material being electrolytically formed out of the lead. Cells employing such plates have a long life. Means should also be provided whereby the approximate state of discharge may be ascertained at a glance, thus enabling the driver to know whether the cells require more or less charge, while systematic inspection is also encouraged by this means, and the liability of the cells being neglected is reduced to a minimum. The Leitner "C" type accumulater, fitted with patent discharge bead indicator, provides for this inspection. The dynamo, in accordance with recognised electrical practice, the concessionaires state, cannot be permanently connected to the battery, as directly the voltage of the former falls below the latter—due to the slowing of the petrol motor below the critical speed—the battery would discharge itself into the dynamo, and tend to drive it as a motor. The serious waste of current involved might be mitigated by various inefficient means, but would depend upon a hand-operated switch. Thus the possibility of a completely discharged battery would depend entirely on the memory

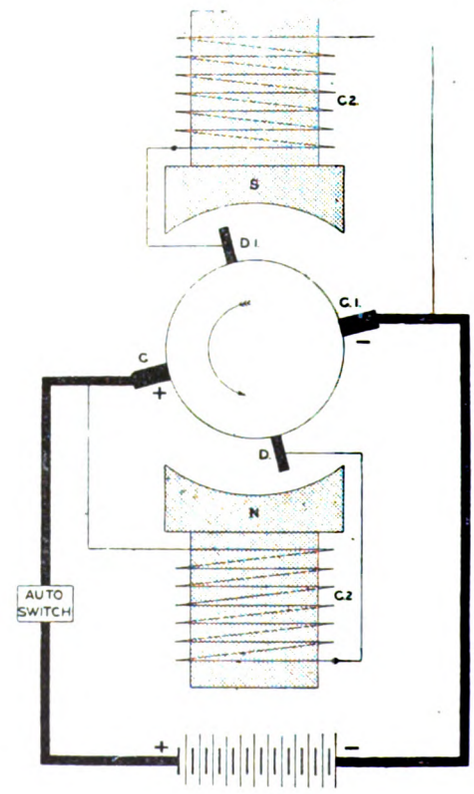

FIG. 2.—DIAGRAM.

and discretion of the driver. No such defects can be alleged against the employment of an automatic switch. The operation of the Leitner Auto-Switch depends not upon speed condition transmitted by centrifugal governors, nor upon electrical solenoid control, but upon true differential electrical action. It is not complicated, and as it occupies very little space, is incorporated with the switchboard, from which not only the lights, but also the dynamo can be controlled and adds greatly to the effectiveness of a car-lighting installation.

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DESCRIPTION.—The regulation qua speed is effected by the employment of two subsidiary brushes, between which and the main brushes the simple shunt field windings are connected. Assuming the direction of rotation to be counter-clockwise, and omitting the theory of generation of current at the main brushes C and C1, the automatic field regulation may be explained as follows :—

At starting, a potential difference is created between the subsidiary brushes D1 and D, the former being positive and the latter negative. This voltage, being in *series*, with the field, G2, *adds itself*, and, therefore, assists rapid excitation.

But as the current on load flowing out of the armature at the main brushes G and G1 increases, the armature flux increasingly distorts the field flux in the direction of rotation, and in consequence the voltage between the

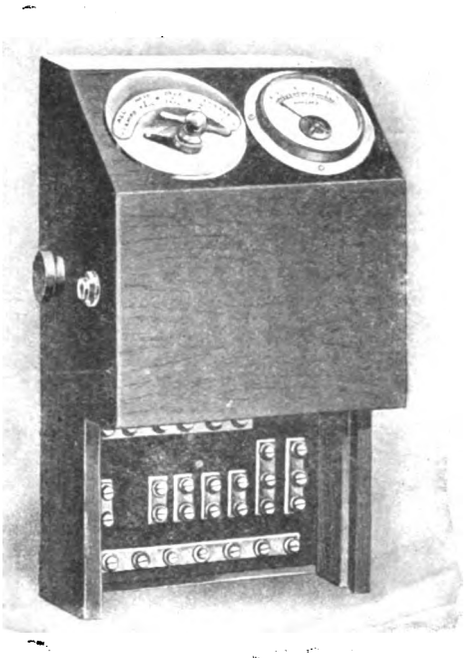

FIG. 3.—AUTO SWITCHBOARD.

subsidiary brushes D1 and D is first reduced to zero and then reversed in sign, D1 becoming *negative* and D *positive*. In other words, counter E.M.F. is introduced into the field circuit.

Increases of speed and load produce corresponding increases of the counter E.M.F., so that in effect the field is weakened proportionately, keeping the voltage on the battery practically constant qua speed variations.

The auto-switch connects or disconnects the dynamo to or from the battery automatically, according to the prevailing electrical conditions, thereby preventing waste. It occupies little space (4 in. × 3 in. × 1½ in.), its action is positive either "on" or "off," and the manufacturers claim that it will not stick, clatter, spark, head, burn out, or fail in any way, it being absolutely reliable, and requiring no attention or adjustment.

PATENTS.

Controlling Electric Motors.

24208.—1909. H. E. DEY, Jersey City, U.S.A. In this apparatus for controlling electric motors a pilot motor is employed which operates the rheostat so as to vary and control the relative strength of the field magnets of the motor.

Power Plants.

27478.—1909. H. A. MAVOR, & MAVOR & COULSON, LTD., Glasgow. This is an improvement in power plants of the kind in which a body is driven by a number of motors deriving current from a number of alternators. The improved alternator generates current of different periodicities whilst driven by a prime mover of constant speed. The alternator has a compound primary magnetic field equivalent to the resultant of independent fields of different pole numbers and an armature provided with corresponding independent windings any one or all of which can be used without altering the primary field.

Electric Flashlight Device.

30000.—1909. H. F. REASON & THE REASON MANUFACTURING COMPANY, Brighton. A pair of solenoids in series connection are arranged one above the other. The contiguous ends of the cores of the solenoids are adapted to close the solenoid and illuminating circuit so that the cores move in a common direction. Means are provided for winding and reversing a fly-train for producing intermittent flashlights.

Electric Switches.

800.—1910. B. BROOKS & F. H. ALSTON, Birmingham. The switch arm is pivoted to a base so as to turn in the same plane. The flat underface of the arm moves over a contact plate fixed to the base. An external terminal is connected to the contact plate, and an inclined jaw overhangs the end of the plate so as to form a space corresponding in shape to the switch arm with which it is adapted to be engaged.

Transmitting Power by Means of Polyphase Alternating Electric Currents.

3117.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. The power transmission is effected by means of a series of polyphase alternating current induction machines. Some of these machines act as generators, while others serve as motors. The machines are arranged and connected in such manner that the two fields in each generator, produced by the currents in the rotor and stator windings if the generator tend to rotate at any instant in opposite directions with respect to their windings. The two fields in each motor produced by the currents in the rotor and stator windings of the motor tend to rotate at the same instant in the same direction with respect to their windings. Means are provided for controlling the electrical frequencies of the currents in the rotor and stator windings and the speed of the motors independently of any alteration of the driving speed of the generating machine.

Supporting Electric Lamps.

23980.—1909. H. T. HARRISON, Westminster, S.W. This suppor for incandescent electric lamps comprises a hood which forms, with the lampholder, a unit adapted to be secured to a pendant or support. A series of spiral springs under tension are arranged radially between the holder and hood and serve as their sole means for connection.

Sanitary Mouthpieces for Telephones.

15448.—1910. J. B. O'HARA, Philadelphia, U.S.A. A cup containing disinfectant material is fitted within a cap inside the telephone mouthpiece. The cup can be easily removed from the cap to which it is held by a central fastening.

Producing Electrical Impulse Charges for Wireless Telegraphy and Telephony.

16356.—1910. S. EISENSTEIN, St. Petersburg. In this apparatus the oscillatory circuit is fed directly with alternating current and consists of a duplicated rectifier valve, the electrodes of which are arranged in opposite directions, but connected in parallel.

Packing Charged Negative Electrodes.

18398.—1910. ACCUMULATEURS TUDOR SOCIETE ANONYME, Brussels. Each plate of the electrode is maintained in a moist condition by means of an impermeable envelope composed of gold-beater's skin, parchment, gutta percha or other suitable material.

Dynamo Electric Machinery.

16448.—1909. A. H. MIDGLEY & C. A. VANDERVELL, Forest Gate. The brushes of the dynamo are sufficiently broad to short circuit individual conductors in the armature. Wound poles are provided which are adapted to excite current in the individual armature coils so short circuited at any moment. Poles are also provided into which the flux is diverted by the influence of the current in the short circuited coils. The diverted flux operates to produce the working current in the external circuit connected to the brushes.

Control of Induction Motors.

16559.—1909. M. MILCH, Nagy-Bittsee. This method of control consists in impressing on the secondary windings, voltages of the required magnitude and phase which are the resultant of the secondary voltages of a pair of frequency converters obtained by relative displacement of their brushes and the points of current supply to the converters.

Obtaining Continuous Current from Alternating Current Circuits.

20867.—1909. A. M. TAYLOR, King's Heath. In this alternating current transformer intended for the supply of rectified currents from the secondary coils the method of increasing the period during which the E.M.F. of the secondary coil remains in the vicinity of zero consists of the employment of a choking coil wound on a separate and unsaturated core and connected in series with the primary coil of the main transformer. The core of the main transformer is highly saturated magnetically.

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Wireless Signalling.

22930.—1909. BRITISH RADIO TELEGRAPH & TELEPHONE COMPANY, LTD., AND J. G. BALSILLIE, London. This device for transmitting and receiving signals by wireless telegraphy or telephony comprises a spring controlled switch lever or key which is pivotally mounted on a base-board. One arm of the lever serves to transmit signals, and is furnished with a contact which when the arm is depressed closes the primary circuit embracing the spark gap. The other arm serves to establish connection with and to cut out the receiving apparatus. Upon depressing the lever to transmit a signal and thereby close the primary circuit the opposite end of the lever is raised and establishes contact with that communicating with the receiving apparatus and earth. Under these conditions the receiving apparatus is short-circuited and at the same time cut out from the air wire. Upon the lever being released the apparatus is automatically restored to a condition suitable to receive a message.

Combined Cable Jointer's Hand Cart and Drum.

23307.—1909. CALLENDERS CABLE & CONSTRUCTION COMPANY, LTD., AND T. PETERSEN, London. The invention consists in mounting an electric cable drum on the axle of an electric cable jointer's hand cart. The flanges of the drum are so disposed that they may form the wheels of the hand cart.

Combined Collector Ring.

23319.—1909. A. S. T. CHAPMAN, Putney, S.W. The device is intended to start petroleum engines fitted with magneto igniting apparatus. It comprises the use of a battery current through a separate contact breaking device independent of the contact breaker usually employed on the magneto sparking device. The battery current is used in the primary coil of the magneto igniter to induce a secondary current, and when broken it causes ignition for starting the engine when the magneto is not running.

Voltage Regulation of Alternating Current Distribution Systems.

23415.—1909. GENERAL ELECTRIC COMPANY, Schenectady, U.S.A. This method of regulating the voltage of one or more phases of a polyphase system consists in adding to the voltage of the phase to be regulated a regulating voltage which is substantially in quadrature with the voltage of the adjacent phase.

Electric Filaments.

24437.—1909. E. RUHSTRAT, Goettingen. The process for manufacturing material for electric incandescent lamp filaments consists in heating the material to such a temperature that it changes into a soft and liquid state, and then instantaneously refrigerating the material which can then be easily ground to a fine powder.

Electric Arc Lamps.

24566.—1909. H. HIRST, AND E. ANGOLD, Salford. This is an improvement in lamps of the enclosed or semi-enclosed type, and consists in the provision of a movable inner tube round the upper carbon. The tube is surrounded by an outer tube down which it can be moved so as to maintain its lower end coincident with the position of the arc which falls as the lower carbon is consumed. By this means, during the whole life of the carbons, a circulation of the enclosed air is established and maintained upwards through one tube and downwards through the other tube so as to deposit the condensible matter from the arc vapours mainly on the inner surface of the outer tube.

Electric Lifts.

4713.—1910. D. E. BARNES & A. A. G. JENSEN, Manchester. A horizontal shaft is fitted near the electric motor. A toothed wheel gears into a pinion on the motor shaft. A flanged pulley is mounted on the horizontal shaft and to this two steel tapes are connected which are either wound or unwound from the pulley for the purpose of hoisting or lowering the lift cage to which their free ends are connected.

Circuiting Arrangement for Working Polyphase, Alternating and Current Motors.

22932.—1909. A. HEYLAND, Brussels. This circuiting arrangement for regulating the starting and speed of mono and polyphase alternating current dynamos is provided with an independent commutator armature introduced between the secondary or induced member of the motor and the net, and connected with a slip ring machine with stator and rotor windings. One of these windings is connected with the secondary member of the motor, and the other is connected with the net, so that the speed of rotation depends on the sum or difference of the periodicity of the currents produced in the secondary or induced member of the motor and the periodicity of the net.

Chains for Suspending Electric Pendants.

22988.—1909. R. J. SIMPSON, Acock's Green. These chains have hollow links made in two equal parts and concave in section. Openings are provided in each end of the link for the purpose of threading the electric wires.

Electric Arc Lamps.

23014.—1909. J. NEU, Nurnberg. In this lamp, in which the electrodes are downwardly inclined towards each other, an electric support is provided pivoted to or fixed to a pivoted plate and adapted to cut out the lamp.

Electric Time Switches.

23161.—1909. HORSTMANN BROS., & W. T. EDGAR, Bath. The time dial is frictionally carried on and frictionally removable from a going-barrel by means of a split hollow sleeve. The attached boss of the barrel is centrally located behind the time dial and forms a bearing pivot for the winding arbor.

Electrical Resistances.

23216.—1909. A. W. MALEY, West Bromwich. These resistances for motor starters consist of a series of grids bent upon themselves so as to form a compact rheostat with no intervening joints.

Control of Electric Motors.

23217.—1909. H. C. LEAKE, Altrincham. A simple ohmic variable resistance is provided in shunt with the armature of a constant current motor so that the motor has a falling torque speed characteristic.

Windings for Alternating Current Motors.

23553.—1909. M. STERN, Glewitz. This is an improvement in the method of winding motor armatures for induction motors of the class in which the regulation of speed is effected by changing the number of poles of the stator from $n \times 8$ to $n \times 6$ and *vice versa*, the winding working three-phase at $n \times 8$ and two-phase at $n \times 6$ poles. The coils of the $n \times 8$ pole three-phase armature comprise long coils arranged at a distance of 720° or its multiples from each other and connected in series. The groups thus obtained are displaced relatively from each other by 360° and are connected in parallel either in the shape of a triangle or a star. The equipotential points of the single groups relatively to the main slip rings of the three-phase winding are connected to the addition slip rings on resistances which become operative only for the $n \times 6$ pole connection.

Dynamo Electric Machines.

23756.—1909. H. LIPPELT, New York. This is an improvement in dynamo electric machines of the type which has a multipolar field and an open coil with means to maintain each armature winding in circuit while it is cutting the flux of the field poles. The improvement consists in the introduction of a condenser into the armature circuit shortly before it is connected to the terminals of the machine or shortly before it is disconnected therefrom.

Portable Electric Lamps.

23808.—1909. G. N. VITANOFF, Harrogate. This is an improvement in pocket lamps of the shape and size of a revolver. The battery is enclosed in the cylinder and the lighting switch forms the trigger which is pressed against the casing of one of the battery cells. The bulb is enclosed in a reflector and is capable of sliding in the barrel.

Apparatus for Heating by Electricity.

23818.—1909. G. G. BELL & J. ST. V. PLETTS, Kensington. The apparatus which may be used for heating or cooking comprises a thermal mass of material capable of storing heat and being a good conductor. The mass is surrounded by a jacket of heat insulating material. A heating device or resistance for the thermal mass is also provided together with a heating chamber and a coil of pipe for water or steam embedded in the thermal mass. A further patent (23819-1909) provides means for ventilating cooking vessels placed within an electrically heated chamber. This consists of a pipe which passes through the walls of the chamber and through the lids of the enclosed vessels.

Coin Controlled Apparatus.

3231.—1910. WESTMORELAND AUTOMATIC MACHINE COMPANY, Irwin, U.S.A. The apparatus comprises a motor and motor circuit. The circuit has an interruption. An auxiliary circuit and a movable member are also provided. In one position the movable member closes the motor circuit interruption and opens the auxiliary interruption, and in another position closes the auxiliary circuit interruption and opens the motor circuit interruption, the auxiliary circuit having a second interruption. When the coin is inserted it is retained in such a position as will enable it to co-operate with a hand-operated switch for closing the second interruption when desired so that the auxiliary circuit is then immediately broken at the first interruption.

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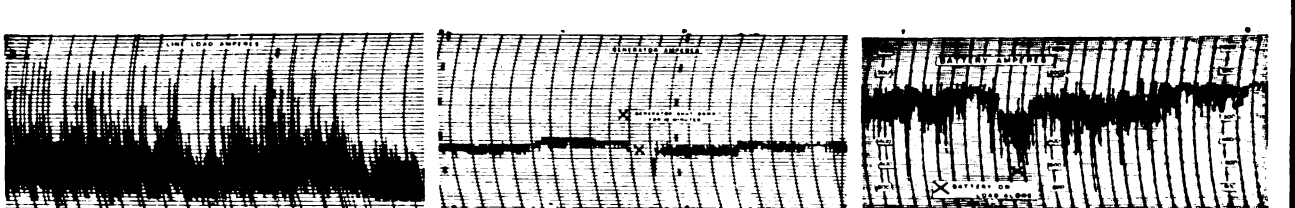

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NOTES.

Technical Schools and Manufacturers.

Considering the widespread interest at present shown in connection with the relation of technical instruction to practical business, it is worth while quoting a significant note from the annual report of Mr. F. W. Atkinson, president of the Brooklyn Polytechnic Institute. He says: "The number of applications for graduates from prospective employers during the year has been large and gratifying as an indication of recognition, on the part of the profession, for the work which is being done in the Institute. The National Electric Lamp Association and the Westinghouse Electric and Manufacturing Company requested and arranged for conferences with the seniors in electrical engineering with a view to presenting the advantages to be obtained in their employment as well as to determine the respective individual characteristics of the seniors. The manager of the Lynn works of the General Electric Company invited the head of this department to attend a conference at Lynn between representatives of technical educational institutions and heads of his departments for the purpose of discussing the relations between technical schools and the manufactory with a view to a co-operative effort aiming at a correlation of the school instruction and apprentice course instruction. The conference was fruitful in suggestions and resulted practically in an arrangement by which graduates desiring to take up this line of work can enter the employ of this company. Applications for a number of graduates were also received from the General Vehicle Company, Western Electric Company, and New York Telephone Company." This is a form of co-operation likely to bear good fruit.

"Wireless" Time.

The authorities of the Paris Observatory, by means of the wireless station on the Eiffel Tower, have for some time past been transmitting time signals to ships at sea from midnight and so on every two minutes. The service is now to be carried on during the day, and ultimately it is proposed that the signals shall be transmitted every two minutes without intermission. This should prove of great help to navigation, especially during bad weather and for the smaller craft, which is an argument for the universal adoption of radio-telegraphic receiving apparatus.

Electrical Targets.

A demonstration of the improved Rose electrical recording target took place last week at the St. Bride's Institute. It will be remembered that when Mr. Sydney A. M. Rose, A.M.I.E.E., brought over his invention from Melbourne some two years ago the idea was very well received. But since then the invention has been completely overhauled and is now a most useful appliance. Although the demonstration was with a miniature rifle range, it is applicable to any sized target, and to any range, from 25 to 2,000 yards, as well as to both fixed and moving targets. The target is electrically connected with a recording instrument at the firing line, and the exact spot is shown instantly. Thus, not only is the necessity for signalling overcome, but a very accurate indication is placed instantly before the marksmen and a permanent record made on rolls of paper. Only three wires are required; the whole apparatus is simple and easily kept in order.

Electrically Lighted Buoy.

Another attractive demonstration took place at the Public Baths, Old Kent-road, S.E., when the Float Electric Company, Ltd., showed the use of an electrically lighted buoy, suitable for both sea and river service. Mr. Wallace Sandy, M.I.M.E., in explaining the system, pointed out that many lives were lost during the hours of darkness which might have been saved had some such device been at hand, and, while acknowledging that there were lighted buoys already in vogue, he believed them to be too bulky and unwieldy for use on the smaller vessels, whereas this invention, being actually the size of an ordinary standard lifebuoy as passed by the Board of Trade, would, he was convinced, be practical in all cases. The buoy weighed only 25 lbs. and proved to be capable of supporting the united weight of three heavy men, amounting to some 35 stone. The lighting, which was effected by two Float patent batteries, showed a brilliant light both above and under the water. A peculiarity of these batteries is that they are sealed, and there is no waste when not in use; the buoy is illuminated the moment it is taken from its rack on the vessel, and will show four lights of nine candle-power for a space of some four hours, thus giving plenty of time to effect the rescue. Two lamps being above the water and two below, a most brilliant effect was obtained when the lights in the Baths were extinguished, and several gentlemen of considerable nautical experience expressed the opinion that the light could easily be seen for some miles at sea.

Postponement of I.E.E. Dinner.

Owing to the General Election, the annual dinner of the Institution of Electrical Engineers (originally fixed for December 6) has been postponed to Thursday, February 2, 1911.

PUBLICITY LITERATURE.

The Electric Supply Publicity Committee are now making a further issue consisting of a leaflet on the use of electric radiators, of handy size, suitable for being enclosed with accounts, correspondence, etc., to consumers; an electric radiator leaflet, with comparative illustrations showing the disadvantages of a coal fire and the great convenience of an electric radiator; radiator mail-card on the same line suitable for use as postcard; adhesive labels, illustrating electric heating, electric ironing, and electric power, in colours, suitable for attaching to letters, accounts, etc., forming an inexpensive means of advertising particular uses of electricity; cooking leaflet, showing illustration of up-to-date cooking apparatus and detailing advantages; leaflet, entitled "Electric Light and Health," giving medical and other testimonies, urging the hygienic advantages of electric light; calendar, attractively lithographed in colours, of a convenient size, so as to facilitate distribution, and ornamental so as to ensure its being kept by the recipient. The calendar forms an excellent method of advertising, since it has a permanency usually denied to other forms, and is just the thing to send to house agents, builders, architects, and others, who will be reminded all the year round of electric supply for various purposes.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION, (Incorporated).—A special general meeting of this Association will be held at the offices, Balfour House, Finsbury-pavement, London, on Tuesday, December 13, at 2.30 p.m., for the purpose of passing the new Articles of Association. This meeting will be followed by a meeting of the Committee.

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STREET LIGHTING BY MODERN ELECTRIC LAMPS.*

By Haydn T. Harrison.

In the very early days of electric lighting the streets which, owing to their importance, required increased illumination, were changed from gas to high candle-power lamps, such as arc lamps; but, unfortunately for electrical engineers, these streets were comparatively few in number compared to the thousands of miles of less important streets and roads which were and are lighted by incandescent gas lamps. Moreover, the high candle-power arc lamps which electrical engineers had at their disposal for competitive purposes gave their maximum candle-power at an angle requiring that they should be placed at a considerable height, and at a short distance apart when required to obtain an even illumination, which resulted in a high cost per mile of lighting. The improvements connected with electric lamps which have taken place within the last two years have placed electrical engineers in a very different position, not only as regards large units of light, arc lamps being now available which give their maximum candle-power in the direction most suitable for street lighting, but also with small units of lights, incandescent lamps, such as tungsten lamps, being available, which give four times the candle-power of the carbon lamps for the same consumption of energy. It was the advent of these efficient small units of light that gave electrical engineers an opportunity of competing favourably with gas for side street lighting, as they can be installed without a heavy outlay in capital. And as most of the streets are sufficiently well illuminated by small light units a very large and valuable load results.

At the commencement of this paper I wish to refer to a statement made by Dr. Louis Bell b fore the Illuminating Engineering Society of America, namely: "Street lighting has been a growth and an evolution, but like all growths it has proceeded to a certain extent along the lines of least resistance; lamps were put, not in the best places for them, but where they could be put in with the least disturbance to individuals." This I have found to be a correct statement of fact, and therefore the engineer of to-day who takes up the question of street lighting will often find that he is required to improve the illumination of the streets, not by rooting up the existing standards and placing whatever sources of light he may have at his disposal in the position suitable for such sources, but by increasing or adjusting the candle-power at the existing points so as to give the best illuminating results at a cost not exceeding and more often less than the existing rate.

In nearly every town and city of this country gas, being the illuminant available at the time when the streets were built, was naturally chosen for the purpose, and electrical engineers have found that in order to displace it they must be in a position to supply lamps of about the same candle-power either at an equal or a lower cost, as it is often not considered advisable to go the expense of scrapping existing posts and lanterns. I propose, therefore, to lay before you the figures relating to the borough of St. Marylebone, where the incandescent gas lamps have lately been replaced by electric (tungsten) lamps. In this case the procedure was as follows: The Electricity Supply Department to the Council was advised by their consulting engineer to ascertain exactly the illumination given by the existing gas lamps, and an outside testing authority intimately connected with the gas industry was instructed to test at random 100 street gas lamps in the district. The results showed an average for the single 4½ cubic feet gas mantles of 50 c.p. and 76·6 for the double mantles. Mr. Arthur Wright having discussed the matter with me, I tested for my own satisfaction, and found that with the single mantles I obtained an average of 45 c.p. and with the double 76 c.p. It was decided that the single lamps should be replaced by two 115 volt 35 watt Osram lamps in series, and the double lamps by two 55 watt lamps. It was then necessary to decide upon the best type of fittings to use, the consideration of which was governed by two important factors, namely, capital cost and effective appearance.

* Paper read before the Institution of Electrical Engineers.

The existing gas lamp-posts and lanterns being the property of the Council, and having been maintained in good condition, it was decided to retain them. The light from tungsten lamps having a profile curve favourable to street lighting it was only necessary to accentuate this by means of reflectors; on the other hand, the use of something which would counteract the effect of high intrinsic brilliancy of the light source on the iris of the eyes had proved in my experience a very important point; therefore I submitted a reflector for this purpose which, after slight modification to suit local conditions, was duly approved. This reflector, which is in shape similar to an inverted wedge with suitably curved sides, attained both of the above objects, increasing the candle-power of the rays near the horizontal to nearly double that of the lamps only and to six times the vertical rays. It is unnecessary to describe the apparatus used as it must be well known to most of you who at some time or other have passed through the streets of Marylebone. I will therefore only enumerate the chief features, namely, a large surface of white reflector above the lamp filaments with no intervening lamp caps or holders, thus attaining the objects mentioned above; anti-vibration holders to protect the lamps from harm due to street vibration, or jars when switching off; suitable watertight D.P. switches and fuses and sealing chambers of sufficiently small dimensions to go between the bottom of the lantern and the top of the post; all of which were designed in such a way that they could be erected at slight cost. It was estimated that the capital cost of converting 1,964 lanterns and connecting them to existing distributors would be £8,000, but owing to excellent systems adopted by the mains engineer of the Council and his assistants the work has actually been done for £5,788, or an average of less than £3 per post, and when it is borne in mind that this work was carried through in three months at an average of nearly 200 posts a week without in any way interfering with the continuity of supply to a single customer, great credit is due to the organisation of that department.

The excellent results obtained have led to the Council deciding to convert the remaining 1,385 lanterns in this district, but owing to these not being adjacent to existing distributors, new ducts and mains were necessary. As these would, of course, eventually have to be laid for private lighting and power supply it is difficult to allot the right amount of capital charges to the public lighting, but even if the whole of this were allotted to public lighting based on a 25-year loan, and the cost of the electric fittings be repaid in three years, £1,640 would still be available for electric supply if the existing gas rate were still charged for lighting. This is equivalent to 0·9d. per unit for the first three years and 1·17d. per unit thereafter. The 1,964 lamps when lighted by gas cost the Council for gas, lighting, extinguishing, cleaning, and maintenance, £8,818 per annum. The gas contractors when asked for a revised tender reduced their price considerably, but were unable to compete with the tenders of the electricity department, which amounted to £7,350 per annum, made up approximately as follows:—

		£	Per Post. £ s. d.
A.	Electrical energy at 1·42d. per unit	3,950	2 0 0
B.	Lighting, extinguishing, cleaning, painting, etc.	1,570	0 16 0
C.	Lamp renewals	1,230	0 12 6
D.	Repayment of cost of electric fittings in three years ..	600	0 6 6
	Total	7,350	3 15 0

It must be remembered that 1,964 street lanterns included in this charge contain lamps of various candle-power; the number are approximately as follows:—

	Measured Candle-power. At 20°	At 10°
335 two 80-watt lamps	135	220
491 two 55-watt lamps	75	130
1,138 two 35-watt lamps	55	100

In dividing them the proportionate cost of each would be approximately as follows when taking energy at 1·42d. per unit:—

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	70 watt.	110 watt.	170 watt.
	s. d.	s. d.	s. d.
A	28 6	45 0	64 0
B	16 0	16 0	16 0
C	12 0	12 0	15 0
D	6 6	6 6	6 6
Total ..	63 0	79 6	101 6

(Each per annum.)

In the above figures the price charged per unit is 1·42d. This figure was not arrived at with any idea of the cost to the electricity department, but in order to repay the cost of the services at an early date. It will be noted that if the charge per unit had been 1d., which is more consistent with the costs of generating, the sum of £3,950 per annum would be reduced to £2,780, which allows £1,170 per annum for repayment of cost of services, etc., the cost of the repayment of the electric fittings being already allowed for; this will easily wipe off the cost of the services in five years; therefore, if a 10 or 15 year loan had been arranged the price per unit could have been reduced to 1d. per unit, which would work out as follows :—

	70 watt.	110 watt.	170 watt.
	s. d.	s. d.	s. d.
A. Electrical energy at 1d. per unit ..	24 0	38 0	56 6
B. C and D. As before	34 6	34 0	37 6
Total	58 6	72 0	94 0

NOTE.—Charges B and C have since been reduced, thus an actual higher rate is being obtained for current.

This brings up the important question of allotment of capital charges. It seems incomprehensible to me that capital charges connected with the services to street lamps should be dealt with differently to those necessitated by an ordinary consumer, and that the loan for them should ever be refused. As a consumer a street lamp is very attractive, the load factor is good, no expensive meters or other apparatus are necessary, and it is not likely to have to be cut off owing to termination of tenancy or vagaries of that description. The street lamp acts as an advertisement to the electricity undertaking, and the local authority controls its own public lighting instead of being in the hands of its bitterest opponent. In the case of Marylebone, not only were all these advantages gained, but a large saving—namely, £1,500 a year—was made in the lighting

Original	Candle-power.	Replaced by	Candle-power at 20°.	Candle-Power at 10°.
Single gas mantle	45	2·35 watt Osram lamp	55	100
Double gas mantle	76	2·55 watt Osram lamp	78	130
Double gas mantle	76	2·80 watt Osram lamp	135	220

(These tests were carried out by the author under identically similar conditions.)

rate, the electricity undertaking benefited, and the illumination of the streets was improved. In the face of all this it would be interesting to know on what grounds the authorities who control the obtaining of loans by municipal undertakings base their antipathy to granting loans for street-lighting purposes. As mentioned above, the illumination of the streets of Marylebone has been improved by the conversion. The tests on the gas lamps mentioned previously are compared with tests on the electric lamps as shown above.

In total candle-power, these figures are very striking, the—

1,964 gas lamps gave a total of 109,000 c.p.

1,964 electric lamps give a total of 146,000 c.p. at 20°, 193,883 at 10°.

As regards the illumination, this was, of course, increased directly in proportion to the increase of candle-power as the position, height, etc., of the lamps remained the same.

The number of posts to the mile varies with the importance of the thoroughfare or street, and also the width of the roadway. The above results take these two factors into consideration, and are calculated from actual candle-power measurements in the street.

It is interesting to note from my paper read before this Institution at Manchester in 1905 that the figures given as an average minimum *direct* illumination taken from a large number of important towns came out as follows :—

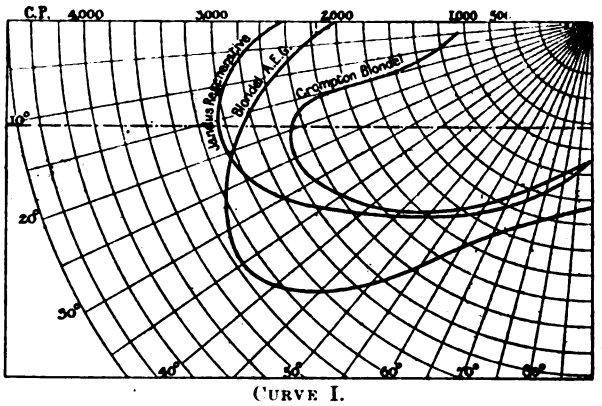
	Average in 1905.	Marylebone, 1909.
Main thoroughfares	0·050 c. ft.	0·15
Side streets ..	0·025 ,,	0·048 to 0·07
Suburban streets ..	0·005 ,,	—

In the important thoroughfares there are an average of 76 posts to the mile, and in the less important streets 65 posts to the mile, so from the above it will be seen that at 1·42d. per unit the cost per annum works out at :—

	£
Main thoroughfares	384 per mile.
Side streets	204 ,,

Or if electrical energy be taken at 1d. per unit, the cost would be :—

	£
Main thoroughfares	356 per mile.
Side streets	190 ,,



CURVE I.

These curves are taken from figures issued by the manufacturers, but are chosen from lamps taking approximately the same watts and having opalescent or similar globes.

Before leaving the subject of the Marylebone lighting, it is necessary to consider a third type of thoroughfare, namely, Oxford-street. With the exception of London and some of the more important towns, there are few places where it is necessary, or where the authorities could afford to illuminate any streets up to the degree attained in Oxford-street; nevertheless, it is interesting to ascertain the cost of illumination up to this standard where necessary, and also to what extent the present cost could be reduced by modern appliances. At the time Oxford-street was changed from gas to electric lamps the most efficient lamps available for the purpose was the converging carbon flame arc lamp. This lamp was therefore used, the globes being of the opalescent type recommended by the makers at that time. Two such lamps were erected on centre poles where favourable, which were at distances of nearly 200 ft., this resulted in a minimum horizontal illumination of 0·11 cubic ft.; thus it will be seen that the cost of this type of lamp works out at nearly £20 per annum. The results are roughly as follows :—

Oxford Street.

Minimum Horizontal Illumination.	Cost per Annum per Mile
0·11	£800

Since that time the arc lamp makers have turned their attention to altering the distribution of light from flame lamps in order to make them more suitable for street lighting.

For instance, in the case of arc lighting it is difficult to arrange for the arc when erected on posts to be higher than 25 ft. from the ground, and the distance between them is rarely less than 150 ft., and is sometimes as much as 300 ft., therefore the light rays which reach the point of minimum

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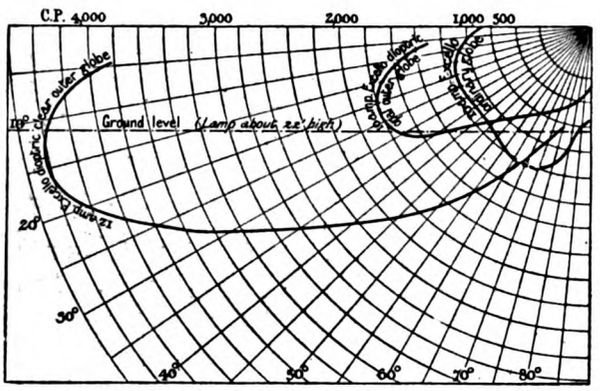
illumination are those which emanate at 10° to 17° from the horizontal. Some tests which I have lately conducted in Oxford-street, Oxford-circus and Regent-street proved these rays to be of the following candle-power (see Curve II.) :—

10-ampere Union flame arc lamp, opalescent globe, 10° to 15° ..	1,100–1,200 c.p.
10-ampere Union flame arc lamp, dioptric and opalescent globe, 10° to 15°	1,750–1,800 ,,
12-ampere Union flame arc lamp, dioptric and clear globe, 10° to 15°	3,700–4,400 ,,

This already indicates the advance one firm—namely, Koerting and Matheson—have made in the right direction by the introduction of the dioptric globe ; for example, if these dioptric globes are used the increased illumination is 60%, without appreciably increasing the cost of maintenance. If a clear outer globe is used the illumination is more than doubled. But Koerting and Matheson are not the only arc lamp makers who have appreciated the importance of light distribution. Messrs. Compton, with the Compton-Blondel lamp, and the Jandus Arc Lamp Company, with their regenerative flame lamp, have both made a great advance in this direction, as has been already demonstrated from the valuable tests carried out by Mr. J. T. Morris* at the East London College. Table I. is



CURVE II.

Candle-power at various angles of flame arc lamps, showing effect of dioptric and other globes.

These are the results of several photometric measurements made by the author in Regent-street, Oxford-circus, and Oxford-street.

compiled from Mr. Morris's figures and further tests taken by myself.

The above figures refer to tests made on the lamps when using the carbons recommended by the makers, which in every case are high-grade carbons with the exception of the magazine lamp, which is a low-grade carbon lamp. These figures can only be taken as a rough guide on account of the question of globes, and also the current at which the lamps are run, which makes far from proportionate difference, low-current arc lamps being always much lower in candle-power output per watt than those taking more current, and this particularly applies to flame lamps. The vertical carbon lamps, though of much higher efficiency, are not so steady burning as the inclined carbon lamps on account of the movement of the arc. I have found in the street when photometering that this variation is sometimes 50%. As regards globes, the absorption of these differs enormously, and the greatest care should be taken in their selection, the only method being by testing the lamps and globes under actual working conditions (see Curve III.).

At this stage, while discussing highly illuminated streets and the use of high candle-power units of light, the relative results obtained by the use of high-pressure gas lamps is of interest. Therefore I will again refer to the tests by Mr. J. T. Morris, from which he draws the conclusion that the candle-power of a high-pressure gas lamp varies 50%, depending on the quality and pressure of the gas. His figures show that from 30 to 34 c.p. per cubic foot of gas consumed per hour is a very average result—this is when working at a pressure of 4 in. of mercury. As my own tests tend to corroborate this, I will take as an example a nominal 1,500-c.p. Keith lamp, which gave on test between 720 and 780 c.p. with a consumption of 23 cubic ft. per hour. This when compared with a flame arc lamp giving 5 c.p. per watt at 1d. per unit, would have to be supplied with gas at 7d. per 1,000 cubic ft. in order to produce the same light for an equal cost, and thus it is obvious that even high-pressure gas lamps do not compare favourably in cost with those high candle-power electric arc lamps, which embody the improvements of the last few years.

* *Illuminating Engineer*, vol. 1, p. 719, 1908.

TABLE I.

Candle-power per Watt of Various Lamps at 10° to 15° from Horizontal.

Type of Lamp.	Watts per Lamp.	Candle-power per Watt.	Type of Globe.
Tungsten..	From 40 upwards	0·8	Clear glass
Grouped Tungsten Lamps ..	300	1·5	In specially designed fittings
Open arc..	500	0·7	Standard opalescent
Encl'd arc, direct current ..	460	0·5	Clear inner and outer globe
Excello flame arc	460	2·4	Standard opalescent
Excello flame arc	460	3·7	Dioptric and opalescent
Excello flame arc	550	6·5	Dioptric and clear
Jandus Regeneration	360 to 460	5 to 8	Standard globes
Magazine lamp ..	350	2·0	Standard globes
Magazine alternating	440	1·6	Standard globes

At the beginning of this paper I referred to the early days of electric lighting, when the open-type arc lamp was the most efficient lamp available, and was therefore erected in considerable numbers for lighting the more important thoroughfares. This was the case in two districts bordering on Marylebone, in each of which nearly 1,000 of these lamps were erected, and are still in use. In one of these districts where they are supplied from the mains of an electric supply company they are spread over nearly 25 miles of streets, the cost per mile of lighting being about £880, and the minimum illumination resulting in this case being 0·05 cubic feet. On referring to the Marylebone figures, where the same class of street is illuminated by means of the tungsten lamps, it will be found that a minimum illumination of 0·08 cubic feet, nearly half as much again, is obtained at a cost of £414 per mile, or less than half. In the other neighbouring district the arc lamps are spread over nearly 37 miles of streets, and are arranged to give two different degrees of minimum illumination, namely, in the important thoroughfares 0·012 cubic feet, and 0·008 in the lesser thoroughfares ; at the prices charged this works out at about £450 and £350 per mile respectively. Comparing this with Marylebone, where the illumination even of the side streets is more than double the first, and sometimes triple, the cost does not exceed £204 per mile.

These examples are sufficient to show that, with the exception of very important streets, the tungsten lamp will give a better result at lower cost than the ordinary open type of arc lamps ; but, of course, where the arc lamp has been used in the past, and the question of improving the illumination and of reducing the cost is under consideration, it would be unwise to incur fresh capital charges by replacing the existing arc lamps with a large number of small posts and fittings, and therefore I propose to call your attention to Croydon, where this problem has been most successfully dealt with. The borough electrical engineer, realising that certain classes of road were not of sufficient importance to require that higher degree of illumination obtainable by the use of flame arc lamps, decided to try the experiment of using groups of tungsten lamps contained in one lantern fixed as high as possible from the ground. The improvement in the evenness of the illumination was very noticeable, and the new form of lighting was generally approved. It was found that a group of three 100-watt Osram lamps contained in a suitably designed and constructed lantern mentioned in Table I., and of which the profile curve of lighting (IV.) is given on page 602 when erected 20 to 23 feet above the ground, gave a much better minimum and much more

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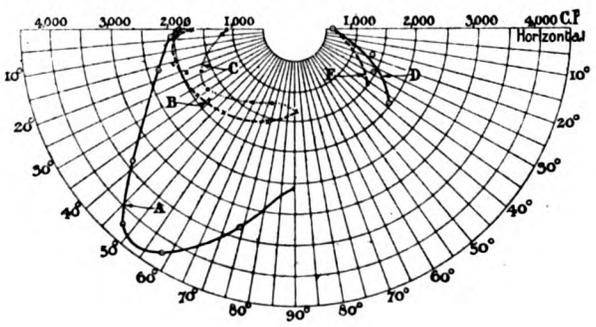
even illumination than the arc lamps, with the result that nearly 10 miles of road have already been converted to this system of lighting. These lanterns, which were the outcome of a considerable number of experiments and tests, carried out by the engineer and his assistants in conjunction with the writer, are designed to embody the same principles as the Marylebone fitting, namely, to have a larger area of white reflecting surface in very close proximity to the incandescent metal of the lamp, with the object of making the source of light appear large so as not to strain the eye in any way. And owing to the height at which these lamps are erected this white surface can be, and is designed to act as an efficient reflector, and does considerably improve the distribution of light by nearly doubling the candle-power at 10 degrees to 20 degrees from the horizontal as will be seen from Curve IV., which compares the distribution from tungsten lamps fitted in these lanterns with that of an open-type arc lamp. The illuminating results are as follows, these lamps being 73 yards apart and from 20 to 23 feet high. The minimum direct illumination is 0·041 when using the tungsten group lantern, against to 0·024 when using the 10-ampere open type arc lamp. The cost per mile works out at approximately £200 per annum, thus a minimum illumination double that of arc lamps is obtained, and at slightly over half the cost. It is interesting to note that when these roads were lighted by gas mantles the minimum direct illumination was 0·0036*, and thus the illumination is now about seven times as high, the cost being about three times greater.

As in many towns the open-type arc lamps have been installed on a series system, it would necessitate considerable expenditure of capital to replace them by the more efficient grouped tungsten lamps if the mains had to be disturbed in order to put in a parallel system of cables, moreover individual switching then becomes necessary, which slightly increases the cost. In order to overcome these difficulties the author has devised a combined lantern and cut-out which permits of the arc lamp being replaced by a group of tungsten lamps, of which one is a spare lamp placed in a conspicuous position in the globe, and comes into operation in the event of any of the other lamps failing. The usual construction of these lanterns is as follows. The lamps nominally in circuit are placed round in a circle and are each connected in parallel through the winding of an electromagnet to the series mains. The spare lamp is placed in centre of the group at a lower level, and is connected through a contact operated by the electromagnet to the series mains. The electromagnet is so wound that when the normal lamps are lighted, and the current is passing through the coils in series with them, the magnet is not excited, but, in the event of a lamp failing, the balance of the ampere-turns is upset, and thus the magnet excited attracts its armature and connects the spare lamp. The advantage of this arrangement is that the automatic cut-in only operates in case of failure of a lamp, thus the contact is rarely made, and the circuit is never broken at the points of contact.

Among other examples of the great improvement possible with modern electric lamps, I would like to mention Harrogate, where the engineer, Mr. Wilkinson, has replaced the arc lamps by four 100 c.p. tungsten lamps, arranged on spreading arms at a considerable height, the result being excellent both as regards illumination and appearance.† It is interesting to note that at Harrogate the lamps are used without globes, but are provided with prismatic reflectors, which leads up to the question of reflectors generally. It is important that the reflectors should be designed with the object of reducing the effect of "glare," in other words, counteracting the high intrinsic brilliancy of the light source. For example, various samples of street lamps and fittings are often installed for inspection of councils and committees, and the writer finds that they invariably turn to him and point out as the fitting giving the most light the one which he has designed with the object of eliminating as much as possible the effect of glare, although very often the illumination derived from the lamp in that particular fitting is no better than the others, but to use an expression which I believe was invented by Mr. Mordey, the seeing capacity is improved owing to the iris of the eye remaining open. Thus it will be seen that a specification that relies only on candle-power or illumination does not always result in the greatest satisfaction to the public. There are many ways of reducing the deleterious effect of high intrinsic brilliancy of light sources, without interfering with the efficiency of the light. In Marylebone, for instance, it is done by the wedge-shaped white surfaces above the lamps being brought down as near the filament or light source as possible. A very ingenious method has lately been invented by Mr. Pragnall, based on the principle that nearly all light sources cover an appreciable area, thus by fixing thin sheets of metal having white surfaces, adjacent and radially to the light source, it is seen in the midst of an illuminated white surface, and not against the dark sky or distant surroundings, while at the same time practically no light is lost owing to the surfaces being thin and radial to the lamp. With arc lamps opalescent globes are very generally used to get over the effect of glare, but the greatest care is necessary in selecting these, as the loss of light is very often a serious matter. This is clearly demonstrated by Curve III. This curve is plotted from tests taken by the author under normal working conditions in the open, and it is interesting to note that the opalescent globe B did not seriously reduce the candle-power of the lamp at the important angles, namely, 10 degrees to 15 degrees, whereas C reduced it considerably.

Some very interesting work has lately been carried out in the City of Westminster in connection with street lighting by gas, and as at the time of writing the lighting of Victoria-street has been completed, the writer has had an opportunity of measuring the illumination and judging the effect of what may be taken as the most modern form of gas lighting. It is not proposed to enter upon any criticism of the local authorities' action in accepting the tender of the gas company, but only to compare the results now obtained with those which existed in the past and those



CURVE III.

A. 10-ampere lamp with clear globe.
B. 10-ampere lamp with opalescent globe, sample 1.
C. 10-ampere lamp with opalescent globe, sample 2.
D. 8-ampere lamp with clear globe.
E. 8-ampere lamp with opalescent globe.

which could have been obtained by other units of light which were tendered for by the gas company. Before going into these figures, it is necessary to examine that part of the specification relating to candle-power, under which the electric light and gas companies tendered. This is somewhat unique, reading as follows: "The candle-power shall be arrived at by taking the average of two sets of readings in any position with regard to the light under test—one set at an angle of 20 degrees and a second set at an angle of 50 degrees to the horizontal." It will be noted that there is no statement that the 20 degrees ray shall bear any definite ratio to the 50 degrees ray. Mr. Jacques Abady, referring to this in his paper on the subject read before the Institution of Gas Engineers, states: "Of course it might be possible for an enterprising individual to make a lamp giving 180 candles at 50 degrees and none elsewhere; and this would be a 90-candle lamp." But a lamp such as this would not comply with the general specification of the Westminster testing clause, and the example is stated simply as a reduction *ad absurdum*." Be this as it may, surely a clause stating what ratio the one ray should bear to the other was necessary, as any individual might have taken advantage of this clause and tendered for converging flame arc lamps with clear glass globes, or direct-current open-type arc lamps, which at 50 degrees give from three to five times more candle-power

* See Author's paper, read before the Institution, 1905, at Manchester.
† *Journal of the Institution of Electrical Engineers*, vol. 44, p. 509, 1910.

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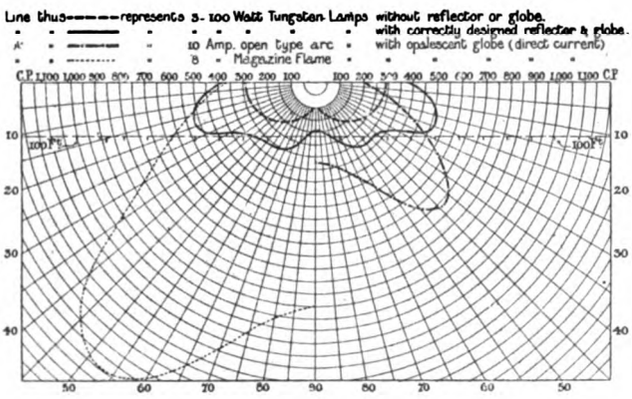
than is obtained at 20 degrees; the use of such lamps as these would naturally have resulted in a very low minimum illumination. As it is the high-pressure gas lamps installed give about 1·5 times more candle-power on the 20 degrees ray than on the 50 degrees ray, which is, of course, a ratio in the right direction, but not sufficiently so to prevent the illumination adjacent to the post being 20 times that of the minimum illumination, whereas with the small gas units displaced it was only 16 times as great, and if the height of the small units had been that of the present units it would only have been twice as great, which would have come under the head of even illumination.

The units of light according to the specification were to be 90 c.p., 180 c.p., 300 c.p., 1,800 c.p., 3,000 c.p., for which the accepted gas company's tender works out at £2 16s. 6d., £4 10s., £6 10s., £15 10s., and £22 per annum respectively. Of these the 1,800 c.p. unit fixed 20 feet high was selected for Victoria-street. This street is approximately 3,600 feet long, and 25 such units have been erected in place of 50 upright double incandescent gas mantles placed 12 feet from the ground, with the result that the mininum illumination has been increased to 0·15 c.p.

The cost of public lighting by electricity naturally depends on three factors:—

1. Cost of electrical energy.
2. Cost of lamp maintenance (lamps or carbons burning, cleaning, lighting, repairs, etc.).
3. Capital charges and repayment of same.


Line thus------represents 3- 100 Watt Tungsten Lamps without reflector or globe.
with correctly designed reflector & globe.
10 Amp. open type arc
with opalescent globe (direct current)
B - Magazine Flame
C.P. 1200 1000 900 800 700 600 500 400 300 200 100
100 200 300 400 500 600 700 800 900 1000 1200 C.P.
100 Ft.
100 Ft.
10
20
30
40
50 60 70 80 90 80 70 60 50

CURVE IV.

The horizontal dotted line shows position of pavement to light angles for lamp 20 ft. high.

Note that the tungsten lamps with reflector give higher illumination than the open arc at any distance exceeding 50 ft. than the flame arc at any distance exceeding 120 ft.

[These curves are plotted from measurements made in the street.]

Item (1) will apply to every type of electric lamp in proportion to the energy it takes, and as opinions vary as to the right charge to make for electrical energy when used in public lamps, I propose to consider this item from a consumer's point of view, arguing that it can make no difference to an electricity supply authority for what purpose it supplies the energy, excepting only that in the case of street lighting a certain amount of credit should be given on account of the advertisement.

All-night street lighting has a load factor of 40 per cent. It is true that it overlaps the peak of the ordinary lighting load, but, on the other hand, it helps to fill up the depression which occurs in the load curve of nearly every station between midnight and sunrise, therefore, as a consumer, it has more value than a power load consisting of motors used during ordinary factory hours. On this score alone it should rank as better than a motor load and be charged less, in which case the large number of electricity undertakings which are supplying power at 1d. per unit for motors can well afford to supply the public lighting at less than that rate, and it is very rarely that the big supply companies or large municipal undertakings ask more than that sum, which they find pays them, as it results in a profit on their generating costs and also covers the cost of repayment of capital in services, etc. The latter should be spread over at least ten years, for there is little doubt that when once the electricity department has obtained the street lighting it will retain it.

In the smaller undertakings where generating costs are proportionately higher, the price of 1d. per unit would appear low. In this case I think a good way of dealing with it is that described by Messrs. Handcock and Dykes, in their paper read before this Institution in November last, namely, to take the standing charges per kilowatt of consumers' demand, which, in the example given, stood at £17, and for a 60-watt lamp would work out at—

$$\frac{£17 \times 20 \times 60}{1{,}000} = 20\text{s. per lamp per annum.}$$

Taking the running charges at 0.4d. and the hours of burning as 4,000 per annum, this works out at—

$$\frac{4{,}000 \times 60 \times 0{\cdot}4}{1{,}000} = 96\text{d.},$$

making a total charge of 28s. per lamp per annum, which works out at the rate of—

$$\frac{28\text{s.} \times 12}{240 \text{ units}} = 1{\cdot}4\text{d. per unit.}$$

Thus, treating the street lamps as an ordinary consumer, a remunerative price per unit may be taken as 1d. for large undertakings and 1·5d. for small undertakings, which includes, as in the case of consumers, the cost of service to the ordinary distributors, but not of fittings, etc., which would come under the same heading as the consumers' wiring and fittings, which are part of the installation. It will be noted that even with this rate of charge the revenue per 60-watt lamp is nearly eight times the average revenue derived from lamps installed in consumers' premises, and moreover, as no meters need be installed and the cost of the services is low compared to that for ordinary consumers, all meter-reading charges are dispensed with and the clerical and office charges are practically nil.

The cost of lamp maintenances must again be divided between two different classes of lamps, namely, incandescent and arc lamps; and as it is essential to know the cost per candle-power per annum in order to ascertain the most economical lamps to use for the purpose and the best method of arranging them, it is necessary to come to some approximate estimate of this figure. With tungsten lamps the cost of lamp renewals at the present price of lamps depends largely on the candle-power and slightly upon the volts, but the following figures which are based on a considerable experience in various towns will act as a guide to the likely maximum, including rates of renewing:—

TABLE II.

Cost of Tungsten Lamp Renewals.

Total Candle-power of Unit.	Cost per Annum (4,000 Hours),	Cost per Candle-power per Annum. Naked Lamp.	Cost per Candle-power per Annum in Special Lantern.
	s.	d.	d.
50	8	2·4	1·3
100	13	1·8	1·2
200	20	1·2	1·0
300	30	1·2	1·0
400	40	1·2	0·8
500	50	1·2	0·6

The cost of lighting, extinguishing, cleaning, and repairs, depends largely on the system of supply, whether from the distributors and separately switched, or from special street-lighting mains, but it will be found that the interest and sinking fund on special street-lighting mains is about equal to the cost of individual switching, and therefore the latter system is likely to be largely adopted, in which case the cost per post may be taken as 16s. per annum, this being constant whatever the candle-power of the lamp. The total cost per candle-power works out as shown in Table III.

The capital charges of electric street lamps, of course, depend upon the value of the posts and lanterns; the cost of the service, etc., being put roughly, they may be taken as follows:—

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Light units up to 200 c.p. (tungsten) erected 12 ft. high £3
Light units up to 500 c.p. (tungsten) erected 16 ft. high 5
Light units above 500 c.p. (arc lamps) erected 20 ft. high 20

The cost of maintaining arc lamps, including carbons, trimming, repairs, lighting, and extinguishing, varies very much with the type of lamp, the enclosed or regenerative type of lamp naturally being the lowest, flame arc lamps burning a good quality of carbon being the highest. In the following estimate it is taken that one man can attend

TABLE III.

Cost of Lighting, Extinguishing, etc.

Total Candle-power of Unit.	Cost of Lighting, Extinguishing, etc., per Candle-power per Annum.
	d.
50	4·00
100	2·00
200	1·00
300	0·66
400	0·50
500	0·40

(Calculated without reflectors.)

to 130 enclosed or regenerative-type lamps and 70 open-type lamps, the cost per annum works out approximately as shown in Table IV.

These results will, of course, vary with the local circumstances, cost of labour, etc., but can be taken as a very general guide. Adding together the previous figures we get the total cost per candle-power per annum exclusive of capital charges, this table including cost of current taken at 1d. per unit.

TABLE IV.

Cost of Arc Lamp Carbons, Trimming, etc.

Size of Light Unit.	Cost per Annum.	Cost per Candle-power per Annum.
	£ s. d.	d.
300 c.p. unit (open type)	4 10 0	3·6
1,000 c.p. unit (flame arc (dioptric globe and opalescent outer) ..)	8 0 0	2·0
3,000 c.p. unit (flame clear outer) ..	8 0 0	0·7
2,000 to 4,000 c.p. unit (regenerative flame) .. ..)	2 10 0	0·3 to 0·15

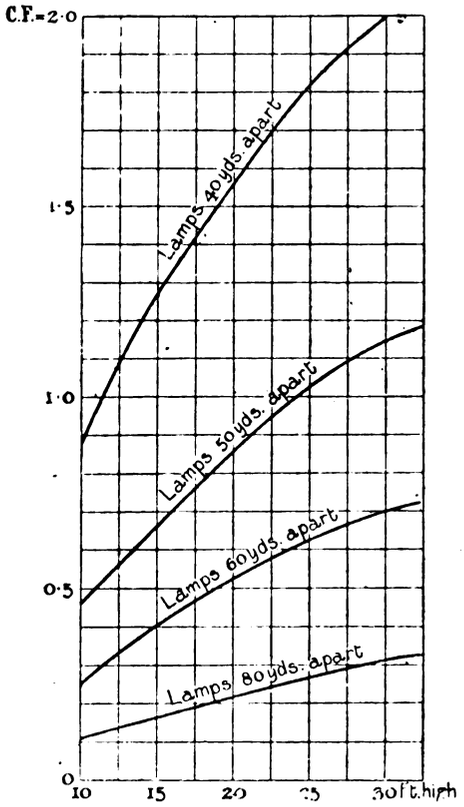
TABLE V.

Total Cost per Candle-power per Annum.

	Candle-power of Light Unit.	Cost per Candle-power per Annum (Total). Naked Lamp.	Cost per Candle-power per Annum in Special Lantern.
		d.	d.
A	50 tungsten	10·50	7·0
A	100 tungsten	8·20	5·0
A	200 tungsten	7·00	4·3
A	300 tungsten	6·66	1·1
A	400 tungsten	6·50	3·8
A	500 tungsten	6·40	3·5
B	300 open arc	10·20	—
C	1,000 flame arc	3·65	—
C	3,000 flame arc (dioptric and clear outer) ..	1·32	—
D	2,000 to 4,000 regenerative flame	1·0 to 0·8	—

Having obtained an approximate table of costs per candle-power per annum for various units of light, it is easy to ascertain which are the best to use under different circumstances. For this reason I have given in Table VI. of the total candle-power necessary to produce a minimum of illumination (horizontal) of 0·1 cubic feet with lamps spaced at different distances and also at two different heights—namely, 20 and 12 feet.

From Table VI. two important features are very noticeable, namely, the large reduction in total candle-power necessary to produce the same minimum degree of illumination with small units of light placed close together, and the effect of height of the lamps on horizontal illumination; this latter point will be dealt with later. It will be noticed that when the lamps are spaced at 30 yards only one-ninth of the total candle-power is necessary to give the same result as when they are placed 100 yards apart, therefore from the table of costs per candle-power it will be seen that unless a lamp giving a very high candle-power at low cost be used, the closer spacing would be the cheaper alternative. Again, converging flame lamps (unless provided with dioptric globes) when erected at 70 yards give illumination at the same cost, equal to small units of light placed between 40 and 50 yards apart, provided, of course, the small units of light are fixed at the same height.



CURVE V.

Variation in horizontal illumination due to various heights of lamps. This curve is calculated on the basis that the lamps are giving equal candle-power at all hemispherical angles. It demonstrates clearly the effect of the cosine factor if horizontal illumination is used for comparison purposes.

With reference to the height of lamps, according to Curve VI., based on horizontal illumination, and obviously in order to obtain even illumination, they should be placed as high as possible; for instance, in Baker-street, if the lamps had been 20 feet high the minimum horizontal illumination on the ground would have been 0·11 c.p. instead of 0·08, or an increase of nearly 50 per cent., but I doubt whether the lighting committee or the public would agree that the illumination of the street had been improved 50 per cent., and am certain that there would be no hesitation in their choice between increasing the height of the lamps eight feet or increasing the candle-power 50 per cent., provided the increased candle-power cost no more. This, to my mind, demonstrates clearly one of the objections to horizontal illumination as the gauge of street lighting, for the increase in the height of the lamps would not in any way increase the illumination of pedestrians and vehicles, or other vertical objects, and it is certainly misleading owing to the introduction of the cosine factor. On the other hand, the specifying of minimum horizontal illumination does encourage raising

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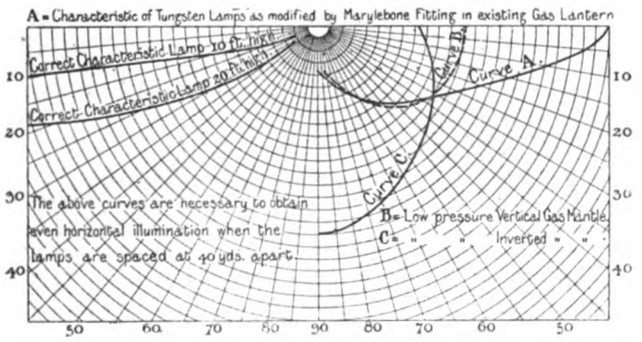
the height of the lamps, but, as I have mentioned in previous writings, the factor of direct illumination covers this point when the maximum and minimum are stated. That the difference between the maximum and minimum illumination at any point of a street should be as small as possible is so important that it is gratifying to note the comparatively low candle-power when measured near the vertical of the tungsten and modern arc lamps, especially when the former are in correctly designed lanterns. For example, maximum illumination with the inclined carbon flame lamps is as high as 10 cubic feet in Oxford-street, with a minimum of 0·11 cubic feet, or a diversity factor of 90. In Baker-street the maximum illumination on the ground is 0·5 cubic feet with a minimum of 0·08, a diversity factor of only 6. Again, in Regent-street, where Excello lamps having dioptric globes are in use, the maximum illumination does not exceed 3 cubic feet, the minimum being 0·23 cubic feet, or a diversity factor of 13.

TABLE VI.

Candle-power necessary to obtain Minimum Illumination 0·1 cubic feet.

Space between Lamps.	Candle-power of Lamps.		Total Candle-power per Mile.	
	12 ft. high.	20 ft. high.	12 ft. high.	20 ft. high.
Yards.				
100	—	8,800	—	156,000
90	—	6,300	—	125,000
80	7,300	4,539	160,000	100,000
70	4,800	3,060	121,000	76,600
60	3,140	1,950	92,000	57,000
50	1,820	1,186	63,500	41,600
40	950	620	41,500	27,300
30	400	300	23,300	17,600

The importance of correct characteristic light distribution is clearly brought out in Curve VI., where the candle-power at various downward angles necessary to produce even illumination is compared with the candle-power given at those angles by: (A) Tungsten lamps with a suitable reflector, such as the Marylebone type, which it will be



CURVE VI.

noticed fairly closely approaches the correct curve. (B) A vertical low-pressure gas mantle which gives about the same curve as a tungsten lamp without a reflector. (C) A low-pressure inverted gas mantle.

The effect of using correctly distributed light is not only more even illumination, but also reduced cost of lighting for a given minimum, which is seen by the following comparisons:—

Position.	Minimum Illumination.	Diversity Factor.	Cost per Mile per Annum.
Baker Street (Electric). .	0.08	6	356
Regent Street (Electric)	0.23	13	660
Victoria Street (high-pressure gas)	0.15	20	540

NOTE.—The tender for the Regent-street type of lighting was subsequently reduced to £425 per mile per annum.

The above figures call attention to the considerable variation in the diversity factor of illumination. The importance of this factor cannot be over-rated. Mr. A. J. Sweet, in his paper read before the Franklin Institute of Philadelphia, states that a ratio of maximum to minimum (illumination) of 4 to 1 is permissible, and points out that the present factor more frequently falls between 100 to 1, or even 500 to 1. For example, in Oxford-street, using flame arc lamps, it is 99 to 1; whereas in Regent-street, where the same type of lamp was used, but with a dioptric globe, this was reduced to 13 to 1. In Victoria-street, the latest example of gas lighting, it is 20 to 1; whereas in the important streets of Marylebone it is 6 to 1. In both Regent-street and Marylebone this great advance was brought about by the correct use of globes and reflectors specially designed for the purpose. It is the possibility of using such globes and reflectors with electric lamps, which gives them a great advantage over gas, where the dissipation of the great heat necessary for the efficient use of mantles makes the use of efficient globes and reflectors a practical impossibility.

For instance, in Victoria-street the light rays from the high-pressure gas lamps which reach the point of minimum illumination are only 1·5 times the power of those adjacent to the lamp-post. In the case of the tungsten lamps in Marylebone they are six times the power—hence the more even illumination. It is interesting to note that if the latter lamps had been placed a few feet higher, and spaced at, say, 100 posts to the mile, the illumination would have been even throughout the street with a diversity factor of unity. At first sight this would appear to considerably increase the cost, but this is not so, as the candle-power of the lamps could be reduced to one-fifth without reducing the illumination.

I must apologise if I have repeated too often examples and figures proving that the multiplicity of small light units results in more efficient street lighting; but the fact that measurements and figures invariably lead to this conclusion proves that it is worthy of the consideration of those who have to deal with street-lighting problems.

I am aware that the average man who is asked to compare brilliant and powerful lamps with the less brilliant but increased number of light sources will generally vote in favour of the powerful light, regardless of the result; but the fact that the Marylebone lighting has given satisfaction to all concerned does prove that in the long-run even illumination is appreciated.

The eyesight of the present generation is suffering from the indiscriminate use of large glaring light units, unsuitably placed. Therefore it is important that those who are called upon to illuminate streets, where the minimum illumination cannot exceed 0·1 of a candle-foot, should not be tempted to accentuate this low figure by producing a few patches of bright light.

It is noticeable that in the past the small-light units derived from gas have been more economical for outdoor lighting than those produced by electricity. The reverse is now the case, therefore electrical engineers should be able to compete favourably, considering that the light they are able to supply is constant, reliable, capable of correct distribution, and easily manipulated, which must result in its adoption for exterior lighting in the same way as it has been so generally adopted for interior lighting.

There is one other feature which I should like to take this opportunity of bringing to your notice, namely, the rating of light units.

It is the custom with incandescent electric lamps to mark them with the mean horizontal candle-power, and they are known by that figure; but if by the use of suitable reflectors or globes this figure is often more than doubled over the angles where the light is required, that unit becomes of twice the value. You will notice that in completing this paper difficulty of this sort has arisen, and that in calculating the cost per candle-power the writer has in most cases given the figures as based on the horizontal candle-power of the naked tungsten lamp; whereas, where they have been erected in suitable lanterns or globes, this cost per candle-power-hour is reduced to a half or a third. This must be carefully borne in mind when using the tables referred to.

Before concluding I would like to thank the many municipal and other engineers who have so kindly sent me

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data which has helped to compile the figures I have placed before you. I am sure you will agree that by the use of modern electric lamps the lighting of our streets and thoroughfares can be carried out both economically and efficiently, and that no electrical engineer need hesitate to tender for this class of work, knowing that, should he obtain it, his undertaking will earn both money and credit, provided that the results are justly and scientifically compared with those of his competitors.

I should like to take this opportunity of warning engineers that good illumination, though the prime object in street lighting, is not the only feature to be considered. Careful thought must be given to obtaining as even illumination as possible; and if high intrinsic brilliancy is carefully avoided the result will be in every way satisfactory, not only to the lighting authorities, but also to the general public.

DISCUSSION.

Mr. Frank Bailey wanted to draw the attention of the authorities to the meagreness and unsatisfactory nature of street lighting at the present time. It was not a question of how little the public could do with, but of how much they ought to have. Street lighting at the present time was very much the same as it was many years ago, which in view of the enormous developments in motor traction and the increased speed of street traffic in recent years, was very unsatisfactory. He considered that the standard of illumination should not be less than that obtained in Cheapside, where centrally suspended arc lamps were used. Better lighting meant fewer police and less crime, and it was not so much a question of improvements as it was more light. He thought the author's price of 1d. per unit a fairly good average, but he was not quite clear how it was arrived at. However, the results obtained with the 1d. fully justified the use of metal filament lamps for street lighting. He acknowledged with feelings of gratitude the assistance rendered them by the author, who had not only worked out the details of reflection, but had also shown how to obtain them in the least possible time.

Mr. C. P. Sparks thought that the Institution of Electrical Engineers might render great service by appointing a committee to draw up a standard specification for street lighting. It might not be adopted in all cases, but it would act as a guide and might be taken as a comparative basis. In street lighting a low diversity factor was required, and the speaker was quite certain that the author's remarks in that respect pointing out the desirability of using proper units in order to get a low diversity factor were of great importance. He considered it the duty of municipal authorities, who owned their own electricity works and who in the early days went in for street lighting, to bring such lighting up-to-date, by scrapping their early open type arc lamps and putting in more modern lamps. The speaker considered the figure of 1d. per unit as the cost of energy rather on the high side, and he felt that unless supply undertakings were prepared to offer energy at a lower rate they would not have much chance of wresting the bulk of the public lighting business from the gas companies.

Mr. A. Hugh Seabrook thought that the figures given in the paper of the tests on gas lamps were very striking. It had been suggested that the price of 1d. per unit charged at Marylebone was on the high side, but considering that the street lighting people were saving about £3,000 a year, it would be rather ridiculous to go below that price. The price had to be fixed according to the price of competitors and on what the stuff would fetch. There seemed to be a great difficulty and dislike on the part of the Local Government Board to sanction loans for street lighting, especially for large concerns. Regarding dioptric globes, Mr. Seabrook considered that these gave considerable glare. He considered the author's figure of £880 per mile over 25 miles of streets with old-fashioned white arcs an astonishing one, as compared with the £800 per mile in Oxford-street. Where a street was wide enough for centre columns, that was the best position in which to put the arc lamps, or any high candle-power lamp. Lamps on the pavement threw an enormous amount of light on the buildings which did not require it. If a street could not be illuminated by means of centre columns, then medium candle-power tungsten lamps should be employed.

Mr. W. A. Vignoles, referring to the author's and Mr. Seabrook's remarks about the Local Government Board, said that he had found from experience at Grimsby that provided the scheme was worked out in detail, the Local Government Board did not set their faces dead against granting loans for street lighting purposes. The author took minimum horizontal illumination as being the standard, but the speaker questioned whether a vertical surface would not be a better standard of illumination to take. It seemed to him that minimum horizontal illumination did not give sufficient information. Recently at Grimsby they had substituted the whole of their existing lamps by enclosed flame lamps, which were far and away ahead of anything yet brought forward. The result was a much better illumination at less cost, the cost for four miles of principal street being about £400 per mile. He agreed with the author's figures regarding the cost of running the various arcs. The cost of running the enclosed flame lamp was vastly different to the cost of running the old open type flame lamps, owing to the saving obtained in the carbons and trimming. He presumed that the object of having two lamps in one lantern at Marylebone was in case one should fail. He would like to know whether in Marylebone there were any fuses except those on the top of the post. He noticed that in Marylebone the cost of alterations was £3 per post. At Grimsby they had carried out the alterations at less than that, but, no doubt, that was due to the fact of cheaper labour.

Mr. A. P. Trotter said they appreciated the paper so largely because it was so full of information which only a practical man such as the author could give. The cost was the matter which determined success in engineering problems. He was not quite sure that he agreed with the author's remarks on the Baker-street lighting, where he said that if the lamps had been raised higher the minimum illumination would have been raised and people would not have appreciated the light so much. That was because the lower diversity factor was appreciated more than the high diversity factor. The mistake which he, the speaker, made when he invented the Trotter dioptric globe—the outcome of which was what was now known as the Holophane globe—was to try and distribute the light uniformly. People, however, did not want that, they wanted changes in their light. There was a great difference between lighting main streets and side streets. A great deal more skill was wanted to get a sufficient illumination in side streets. The advent of the metal filament lamp, however, made efficient side lighting possible, where before with the carbon lamp it was hardly possible.

Mr. Leon Gaster agreed with Mr. Trotter that side streets were as important as the main streets as far as lighting was concerned. He also agreed that a Commission should be appointed to draw up a standard specification for both indoor and outdoor lighting. The present-day method of deputations parading round and having dinners was not the way to test lighting. Regarding the question of glare, he considered that most of the accidents which occurred were due to that cause, and the avoidance of glare was one of the most essential features in street lighting. He thought that the Institution of Electrical Engineers should recommend the appointment of a Committee, having Mr. Harrison, Mr. Trotter, and other people to investigate and satisfy the authorities and educate the Local Government Board that street lighting ought to be properly specified.

Mr. W. R. Cooper wished the author to explain what was meant by the term candle-power. It was quite possible with lamps fitted with reflectors, more particularly with dioptric globes, that the ordinary term candle-power did not apply. Had the author tested that point at all?

Mr. C. H. Shaw said that at Worcester they had found it wiser to scrap the whole of the existing lanterns and use no glass at all. Lanterns did certainly increase the light for about a day, but after that time they got dusty, with the result that the light decreased. As regards price, they would have to get a very much lower price than £3 15s. in the provinces if they were to make any progress in competing with the gas companies. At Worcester they had a scheme using overhead wires fixed to the tramway poles, and using the brackets on the poles to hold two 50 c.p., two 35 c.p. or 100 c.p. lamps, according to the type of street. They had a standard price of £2 8s. 6d. for all

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candle-powers. The cost of fitting up the equipment, including fittings and first charge of Osram lamps, worked out at £195 per mile. The lamps were fitted 16 ft. from the ground. The illumination was perfect, without the slightest glare, and the citizens were extremely pleased with it.

PROF. J. T. MORRIS said most people considered that in street lighting the sources of light should be visible, as it gives the more decorative effect. He submitted that to light a street well the decorative effect should be dismissed and the lamps screened down to 15 degrees below the horizontal. At Marylebone he had noticed the diminution of glare produced by having a brilliant white surface above the lamps, and in order to test this he had made some measurements of the size of the pupil of the eye under three conditions: near, with the bare filament; with a mirror behind, and with a sheet of white paper behind, and found that the white paper was the more restful to look at. When the mirror was placed behind the lamp the pupil contracted 85%, and with the white paper behind the pupil contracted to a proportion of 110%. Therefore the white surface was not only more restful to look at, but at the same time gave a considerable amount more light. Sudden changes in illumination were bad.

MR. NEWTON RUSSELL: At Shoreditch they had cleared out 300 or 400 gas lamps and replaced them with 50 c.p. and 100 c.p. tungsten filament lamps, with the result that better light was obtained, the Council saved money, and the lighting station benefited. He was collecting data with regard to the life, etc., of the metal lamps, and proposed to send it in to the Institution.

MR. EDGCOME hoped that the Institution would be able to carry out the proposal that they should appoint a Committee to draw up a specification. The only point was whether it would be politic for the Institution to do it on their own without inviting representatives from the gas industry and possibly from the surveyors as well.

MR. H. L. P. BOOT considered that centre lighting should be used in side streets. The cost of energy for street lighting was far too high, and instead of being in the neighbourhood of 1d., he found from actual tests that it was nearer ½d. per unit. That, too, was for small towns. He considered that one of the greatest obstacles to the progress of electricity for street lighting at the present time was the high cost of the metallic filament lamp.

MR. J. S. DOW thought that local private lighting should be encouraged by engineers. It was surprising how much light could be obtained in that way.

MR. HAYDN T. HARRISON quite agreed with Mr. Bailey's remarks. The lighting in Cheapside was, no doubt, the correct method, but it had been installed so recently that he had not had time to make any tests there. He would imagine, however, that the minimum illumination was very high. In London, particularly, more money should be spent on street lighting. Regarding the matter of glare, Cheapside, with its centre lighting, was a very interesting case. He was not altogether in favour of centre lighting, as he considered that it was not altogether good for the drivers of omnibuses, etc., because the lights were very nearly in their line of vision all the time. The question of specifications mentioned by one or two speakers, while being a very important one, was a very difficult one, because the gas people could not be ignored altogether, and it was very doubtful whether it could be generally adopted unless it was mutually agreed upon. Such a specification should be passed by the Civil's, or a society to which surveyors and gas people belonged generally. He knew that 1d. per unit was on the high side, but if an engineer told his Committee that he wanted to supply current for street lighting at 0·75d. per unit he would be told not to talk nonsense. The question of Local Government Board loans had told more than anything else against street lighting. Mr. Trotter had misunderstood what he, the author, had said about the fact of increasing the height of the lights increasing the illumination by 50%. What he said was that "people would not appreciate the 50% increase in illumination." The lighting of small streets certainly did require very careful consideration. Regarding Mr. Cooper's question as to what he meant by candle-power, he had been very careful to explain that point towards the end of his paper. Regarding Mr. Shaw's statement that at Worcester they were able to light their streets at less than £204 per mile, it must not be forgotten that he had only got with tramway poles 44 posts to the mile, whereas in Marylebone they had 65 posts to the mile, which made a considerable difference. Prof. Morris's tests corroborate what one would have expected to find.

A hearty vote of thanks having been passed to the author, the meeting terminated.

TELEGRAPHIC AND TELEPHONIC REFORMS.

Speaking in the House of Commons on Monday night, the Postmaster-General, Mr. Herbert Samuel, announced a number of important changes in the charges made by his department.

Chief of these was the reduction by one-half of the telephone rate for conversations between London and Paris. This has been 8s. in the past: in the future it is to be 4s. This will come into effect as soon as the French Government have ready the additional land wires which are necessary.

Proposals for a considerable reduction in cable rates on the chief European routes for messages in plain language and of a non-urgent character were under consideration. No statement, however, was at present possible, as negotiations with foreign Governments were necessary.

Extensive alterations were being made in the number and equipment of wireless telegraph stations for communication between ships and the coast.

Finally, arrangements are under consideration to facilitate the general use of telephone numbers instead of house numbers for telegraphic addresses, so that telegrams might be delivered by telephone instead of by messenger.

FINANCIAL NOTES.

ISLE OF THANET ELECTRIC TRAMWAYS.—For the year ended September 30, the accounts show a disposable sum of £11,027, out of which the directors recommend a dividend of 2½% on the Preference shares, as compared with 1½% for each of the two preceding years. It is proposed to place £2,500 to reserve account and to appropriate £2,500 towards future maintenance of permanent way, carrying forward £2,277.

* * *

CAPE ELECTRIC TRAMWAYS.—The net profit for the past year shows an increase of over £13,000. Out of this various debit balances, amounting to £8,654, have been paid. The directors hold forth hopes of paying dividends next year.

THE SUPPLY OF ELECTRICAL ENERGY.*

By A. H. Perrett.

The paper deals with the application of electrical energy to public and private supplies. After enumerating some of the chief uses to which electrical energy is put, it goes on to a consideration of the subject of generation, dividing it broadly into two groups: (a) by primary batteries; (b) by dynamo machinery. Treating the subject of the production of electrical energy by dynamo machinery from the point of view of its subsequent use, the application to a purely lighting load in private establishments is first investigated, and, continuing on these lines, works and factory plant comes next. In this connection numerous examples are given of existing plant in different parts of the world. Turning to the public supply, a number of figures are given which show that the demand for electrical energy is steadily increasing. Some interesting details referring to house supplies are next given, and the paper closes with a consideration of the supply of electrical energy to marine work.

* Abstract of a paper read before the Northampton Institute Engineering Society, on Friday, Dec. 2, 1910, with Dr. R. M. Walmsley in the chair.

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Displayed Advertisements intended for insertion in the current week's issue, and alterations for standing advertisements, must reach the offices by 9 a.m. on Monday if proofs are required.

Contracts, Patents, and Small Advertisements by 9 a.m on Wednesday.

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Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

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WATER POWER OVERSEAS.

Last week we referred to the great possibilities for the development of the electrical industries the comparatively small rivers of the United Kingdom and Ireland offered. But, of course, far greater opportunities occur in lands over the seas. In Scandinavia this natural source of power early attracted attention and was developed on a fairly large scale, but now a great impetus is to be given to hydro-electrics both in Sweden and Norway. The already large use of water-power in Switzerland, France, Italy and Spain is also being extended, and we find the same alacrity to secure cheap power in the United States. It is seen by industrial leaders that much advantage may be derived by such schemes, for, of course, the manufacturer provided with cheap power is greatly benefited. The truth of this is clearly realised, not only in the self-governing Dominions of our far-spread Empire, but also in India. In the latter country three big hydro-electric schemes are being developed, that of the Cauvery River, in Mysore, supplying the Kolar goldfield; that of the Jhelum River, in Kashmir, the power being chiefly utilised for irrigation and flood-prevention purposes, and the most promising Tata scheme in Bombay, where the electricity is to be utilised mainly in the development of textile and other industries. In New Zealand the Government is wisely taking time by the forelock and securing the utilisation of the water-power for generating electricity as a Dominion monopoly, for the benefit of the whole community. In Australia hydro-electrical schemes are receiving more and more attention, and in many cases we find a number of townships within a shire combining to take electricity for lighting and power from some central hydro-electric station. In Canada the Government is also alive to the necessity of keeping some form of control over the immense water power now running to waste in so many districts.

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The Government Dominion, however, permits of a fair amount of elasticity as regards local developments, and in most instances the provinces are keenly alive to the advantages that systematic exploitation of their water-power offers to their general plans for development. The latest illustration of this is afforded in Manitoba, where we find Winnipeg adopting a huge hydro-electric scheme with the avowed purpose of attracting outside capital to open up big factories there, so that Winnipeg may eventually become not only the chief mart, but the manufacturing centre of the Middle-West. It is somewhat disappointing to find in too many of these schemes that only a comparatively small percentage of the machinery and appliances are of British make or design. The truth is, our German and Swiss competitors, as well as our American cousins, have paid far more attention than we have to the economic conversion of water-power into electric power, and consequently when these important and costly hydro-electric projects are to the fore, they stand a better chance in securing contracts than we do. It is a state of affairs that need not exist, and seeing how largely the exploitation of water-power is likely to bulk in the immediate future, it is a state of affairs for which a remedy should speedily be found.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways and tramways, mining installations, electric power in workshops electro-metallurgical plant, and electrical engineering work generally.

Questions.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

Answers.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the apparance of the questions.

QUESTIONS.

Question No. 1236.—Mention the points controlling the design and operation of "*surge tanks*" in hydro-electric schemes. Are such tanks essential? Also, what dangers attend omission thereof or wrongful design? Give practical design rules if possible.—"Collier."

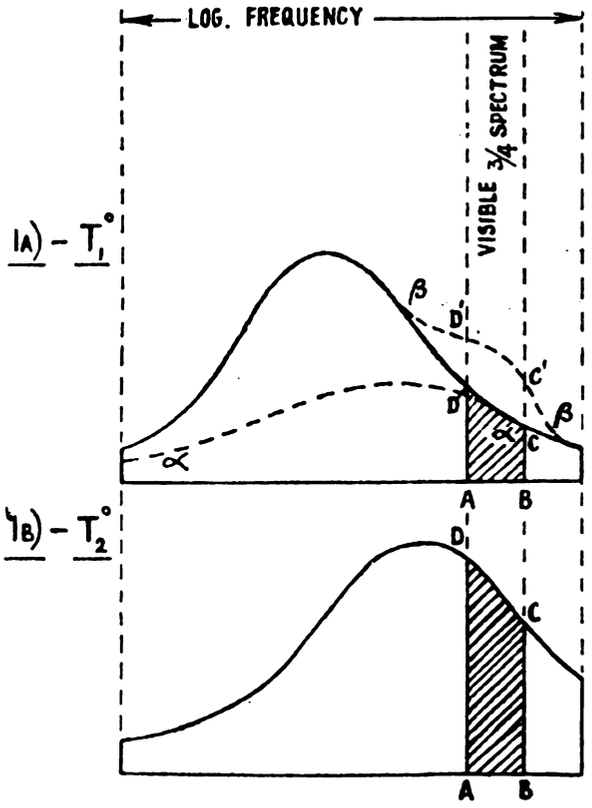
Question No. 1237.—Describe some ships' electrical steering gears that are in use, such as the "U. E. G." and Pfalischer systems, giving both electrical and mechanical details. Are there any systems where purely electromagnetic reversing clutches in combination with a continuously running motor are used? If so, what is the best clutch to use? and if not, what faults do such clutches develop?—"Two Points."

ANSWERS.

Question No. 1233.—Explain briefly why the efficiency of commercial lamps (electric) is so low? State ratio of best present efficiency to theoretical efficiency, and indicate the most hopeful means of improving the former. Does luminescence seem likely to become valuable? What is meant by selective radiation? Distinguish between arc lamps and vacuum tube lamps (electrically) and comment on the value of arc lamp equations.

Answer to Question No. 1233 (*awarded* 10*s.*).—It is not generally realised how low the efficiency of the conversion of electrical to luminous energy actually is; whereas dynamos and motors convert mechanical to electrical energy (and *vice versa*) with an efficiency of 90–95%, steam engines utilise as much as 60% of the total available energy in the steam supplied to them, and gas engines convert to mechanical energy perhaps 30% of the total thermal value of their fuel; many incandescent electric lamps have an absolute efficiency of less than 1%, and the utmost efficiency that *could* be attained by mere incandescence is 5–10%.

The reason for the latter unsatisfactory result is that heated bodies only begin to radiate lumionus rays at a high temperature; of several complete octaves of radiation, only some ¾ octave is visible to our eyes; this limited range is far up the total scale of emanations, and the *lower* (and, for the present purpose, idle) *emanations* form the greater percentage of the total, and *cannot be omitted*. As the temperature of the radiating body increases the frequency at which maximum intensity of radiation is occurring moves towards the shorter wave lengths of the spectrum. At about 4,000°–5,000° C. this maximum would come within the visible ¾ octave, and the *highest possible efficiency of incandescent illumination* (¼–½ watt per c.p.: 10%–5% actual efficiency) would be obtained.



Carbon is the most refractory known material, and in the crater of the carbon arc (where carbon boils) a temperature of 3,500° C. is reached, and an efficiency of 5% (reduced by air currents, conduction along electrodes, and so on) approached. In filament lamps, however, full advantage cannot be taken of the refractoriness of carbon: the latter begins to sublime if heated much above 1,800° C., and, though tantalum, tungsten and osram are less refractory than carbon, they can be run, as filaments, at much higher temperatures (2,000–2,200° C.), and are, therefore, more efficient in practice. Metallised carbon is much superior to the untreated carbon filament, but it is doubtful whether anything more efficient than the rare metal lamp can be evolved to employ incandescent filaments. Probably the limiting possible efficiency of a filament lamp is ¾–1 watt per c.p. (corresponding to 2½–3½ actual efficiency), and a relative efficiency of 25%–33% (with regard to the maximum possible efficiency of 10% by incandescence).

Selective Radiation.—The effect of higher temperature in increasing the ratio of luminous to total radiation is shown in Fig. 1 (assuming, as is the case with most bodies, radiation according to the "black body" laws). The ideal of selective radiation—realised to a considerable extent in the Welsbach mantle and Nernst glower, and to a much less extent in metallic filament lamps—is to secure a specially high percentage radiation within the visible range of frequencies *either* (1) by an abnormally small radiation outside this range (curve α α Fig. 1, *or* (2) by an abnormally great radiation within the visible range (curve *B B* Fig. 1).

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As the efficiency of the lamp rises, by the utilisation of higher temperatures, the benefit of selective radiation decreases (thus the additional radiation DCC'D", which may be 50–100% of ABCD in Fig. 1r, may be only 5–10% the corresponding area in Fig. 1b). For a similar reason the improvement effected by the Nernst lamp over the carbon lamp was much less than the analogous advance of the Welsbach over the flat-flame gas burner; the efficiency of the carbon lamp being far higher than that of the flat-flame burner, the relative advantage of selective radiation was reduced.

Luminescence.—Owing to the relative freedom of the molecules of a gas, the latter can vibrate at a definite frequency, and thus emit luminous radiations without, necessarily, any low frequency, ultra-red or high frequency, ultra-violet waves. It is thus theoretically possible to secure from a luminescent gas 100% efficiency of conversion from electrical to luminous energy, and the impossibility of realising this result in practice is simply due to the fact that no known gas gives, on luminescence, all its "lines" in the visible range of the spectrum; nevertheless, it is to luminescent gases and vapours that we must look for the really efficient conversion of electrical (and so mechanical) energy to light.

It is impossible to induce in a gas, by heat, that steady vibration of its molecules which constitutes luminescence. Such a motion can, however, be set up by the passage of an electric current through the gas. A series of emanations of definite frequencies (dependent only on the gas employed) is thus created, and the only effect of increased temperature (apart from pressure changes) is a variation in the relative prominence of the various spectral lines, and hence in the colour of the light evolved.

Heating a luminescent gas increases the percentage of non-luminous radiation, hence the cooler the source the better—a result in direct contradiction to the condition for luminous efficiency by incandescence. (Hence among arcs depending upon luminescence (and *not* upon incandescence as does the pure carbon arc) the comparatively cool mercury arc is one of the most efficient).

Mercury, cadmium and titanium give luminous arcs, and a high percentage of their "luminescent" radiation lies within the visible range of the spectrum; such arcs are, therefore, highly efficient, and should run at a low temperature (from the efficiency point of view). They avoid to a large extent the intermediate heat stage in the transformation of electrical energy to light and, in common with "flame" arcs, reach efficiencies wholly unattainable by incandescent lighting, but still sufficiently low.

Carbon and silicon, however, give practically no *luminescent* radiations from their arcs within the visible range of frequencies; hence such arcs must be run at as high a temperature as possible, fully 80–90% of the light emitted coming from the *incandescent* crater.

Vacuum Tubes.—By the passage of a high tension, and (preferably) high frequency discharge through a rarefied gas, light is obtained by a species of luminescence, but the efficiency of such lamps is comparatively low and the intrinsic brilliancy inconveniently small. Though developments may be expected in this form of lamp, it is, as yet, of very restricted application.

A brief comparison between certain properties of vacuum discharges and arcs is given in Table I.

TABLE I.

	Vacuum Discharge.	Arc.
Conductor ..	Rarefied gas ..	Vapour from – ve electrode.
Spectrum ..	That of gas ..	That of – ve pole.
Effect of electrode material.	Nil	All-important.
Heat generated ..	Very moderate ..	Intense.
Critical voltage ..	Voltage necessary to start discharge must be maintained (very high)	Once arc is struck, voltage need only exceed the moderate "back E.M.F." (20–40 volts).
Striking	Working voltages suffices	By contact and withdrawal of electrodes or by high tension spark.
D.C. or A.C. ..	Immaterial: A.C. somewhat preferable	D.C. preferable; carbon arc runs on D.C. or A.C. alike, but some electrodes (*e.g.*, Hg.) require A.C. arc to be re-struck (by spark) at each half cycle.

"Flame" Arcs.—In this type of lamp a normally invisible arc is rendered luminescent by the injection into it of suitable vapours *either* (1) by the utilisation of the "vapour blast" from such negative electrodes as iron or titanium; *or*, (2) by the evaporation of salts (usually of calcium) with which the positive electrode (as being the hotter) is impregnated.

In the first case, the negative electrode may be water cooled, and burns very slowly; the positive need hardly burn at all; the characteristic of the arc is that of the negative electrode. In the second case, carbon usually gives the best results as electrode material; the positive is very hot and burns rapidly; the characteristic is that of carbon.

Arc Equations.—Voltage-current equations are quite satisfactory for arcs burning pure electrodes of normal size; for long, thin arcs, however, such equations become unreliable, and for cored or impregnated electrodes they are of very restricted utility.

General.—The light equivalent of energy is nil in the ultra-red and ultra-violet regions, and, in the dark red and dark violet, is only about one-tenth its value in the yellow part of the spectrum. It therefore follows that, for a given energy expenditure, most light can be obtained from a source emitting yellow or yellow-green light. Physiological considerations require, in the main, a greenish light, while for blatant advertising effects a yellow glare is most valuable. The qualities of daylight have, however, educated (or prejudiced) the average user to require an artificial light as nearly as possible resembling sunlight. It will usually be found that all such steps as those taken to secure long lamp life or long burning hours or a "better" colour, sacrifice efficiency to a greater or less extent.—"MINER."

CATALOGUES AND PRICE LISTS.

The following trade publications have been received:—

General Electric Company: (1) "Witton" Primary Cells; (2) Shop Lighting Fittings: Lanterns and Reflectors, Advertising Signs, etc.

Bastian Electric Heating Syndicate Ltd.: (1) Attractive show card; (2) Illustrated booklet on cooking; (3) Leaflet on Bastian "Quartzalite" Coffee Percolater. All these may be obtained from the various wholesale selling agents.

The Electric Ordnance Accessories Company, Ltd.: Illustrated price list of "Eclipse" electric heaters.

The Kuhn Tube Cleaner Manufacturing Company: Improved boiler tube cleaner.

Tetley & Company: Illustrated price list of "Falcon" watertight ship and mill fittings for carbon and metallic filament lamps.

The Palmer Tyre, Ltd.: Electrical tyre testing machine pamphlet entitled, "Lost between the Wheel and the Road."

The Pearson Fire Alarm, Ltd.: Illustrated descriptive pamphlet and price list.

Siemens Bros. Dynamo Works, Ltd.: Illustrated catalogue of Arc lamps for Continuous and Alternating currents.

United Motor Industries, Ltd.: Illustrated pamphlet "Mea" Arc Light Magneto.

The Sandycroft Foundry Company, Ltd.: Catalogue of storage batteries.

The Silent Electric Clock Company: Illustrated booklet and price list.

A. Reyrolle & Company, Ltd.: (1) Leaflet No. 55 on Double Revolution Drum-Type Starter Regulator; (2) Leaflet No. 140, on Controllers.

W. H. Willcox & Company: (1) Pamphlet on Lubricating Oils; (2) Renault Motor Oils and Grease.

Foster Engineering Company, Ltd.: Neat descriptive folder, with space for retailer's name and address.

The Electric and Ordnance Accessories Company, Ltd.: Folder dealing with "Eclipse" Electric Heaters, with space for dealer's name and address.

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THE LATE MR. GUSTAV BYNG.

It was with deep regret that we learnt of the passing away of Mr. Gustav Byng, at his residence, Fitzjohn's-avenue, on the 23rd inst., at the early age of 55. Though in the past quarter of a century he had taken a great part in developing what was at the commencement of his labours, the infant science and industry of electricity, yet it seemed a cruel stroke of fate that in the prime of life his fertile talent should be withdrawn from the industry for which it had done so much. Unfortunately, for many years past his constitution had been undermined by a mortal complaint, against the remorseless advance of which he made a brave but unavailing fight. A few years since his health became too impaired to allow him to take much part in the administration of the important firm, of which, in conjunction with his close friend and co-worker, Mr. Hirst, he had been founder some 27 years ago. Nevertheless, he continued to take the deepest interest in the General Electric Company, in which, as Chairman, he was no mere figure head. Almost to the last his valuable advice and genius for finance and

decision in affairs were ever ready to provide new paths for the irresistible march of the company and its many subsidiary organisations. His marvellous gift for finance was not the least potent of the forces which raised the General Electric Company from comparatively small beginnings to its present proud position amongst the electrical companies of the world. To the late Mr. Byng's family his loss is, of course, the most cruel blow, yet they have one great consolation, inasmuch as he was privileged to enjoy what has been denied to many great men who have made their mark in the world. It was his happy lot to see two of his sons taking an active part in the business; one of these young men, as a member of the directorate, has developed a remarkable aptitude in practical organisation, and displayed great business acumen. A third son, who carried off a gold medal at Faraday House, is pursuing a further course of studies at Harvard University, while a fourth son is studying law with a view to joining this great firm in another capacity.

To even summarily describe the late Mr. Byng's career as an electrical engineer would require a considerable amount of space. Born in Bavaria in 1855, he received a sound German education at the Augsburg Polytechnikum, a school of higher general scientific instruction. Coming to this country at the early age of 18, in 1873, he elected to make it his home, and in 1879 he became a naturalised Englishman. It was about this time that he commenced business on his own account as an electrical engineer and manufacturer of electrical apparatus. The electrical industry was at that time in a very primitive condition, especially in this country; those pioneers of the industry who are still with us will testify that it was in a measure due to the indomitable energy, the foresight and business acumen of Mr. Byng that the foundations of the industry, as it now exists in this country, were so firmly laid. German by extraction, he quickly became a devoted son of the land of his adoption, and it was a great pride to him to see this British industry, after many discouragements and difficulties, take its place in the world's front rank. Happily for him, he found a kindred spirit and co-worker in Mr. Hirst, whose administrative talents and technical ability were of the utmost value to him in the great work of his life—the building up and constant expansion of the General Electric Company. This great work has occupied some 27 years. The works were originally at Manchester, where the cradle, so to speak, of this great industry is still to be seen in the old Pell Works, where the Pell-Connor telephones are now made. But the main works of the company were moved some years ago to Witton, near Birmingham, where 106 acres were purchased as the site of the necessary workshops and other buildings. The late Mr. Byng took the keenest interest in this great work of development, and supervised with the greatest care the necessary financial arrangements. At Witton there are now, besides engineering shops for the manufacture of the largest electrical machinery, spacious arc lamp and switchboard shops, electrical carbon and chemical factories, steel and brass tube works, an iron foundry and power house with a present capacity of 2,500 h.p. Mess-rooms for the employés, club houses and workmen's cottages are also to be found adjoining the works. No less than 8,000 people are now employed in the various manufacturing and other establishments of the firm in this country alone, which has other large factories at Sherlock-street, Birmingham, and Union-street, London, and extensive showrooms and branch offices in London, Manchester, Glasgow, Birmingham, Newcastle, Cardiff, Belfast, Dublin, etc., whilst it is also represented by branches and agencies in almost every commercial centre in the whole of the world. The General Electric Company is the parent from which the well-known Robertson Electric Lamps, Ltd., Osram Lamp Company, Pell-Connor Telephone Company, and the other subsidiary companies have sprung. Several of these companies have found a foothold abroad, on the Continent, and in the British Colonies. Indeed, Mr. Byng lived to see the General Electric Company truly a world power. Great work of this description could not, of course, have been accomplished without the display of the greatest business and financial ability—qualifications which the departed founder of the General Electric Company possessed in the highest degree. As for his part in the progress of electrical invention, he did much useful work. He was in his early days an indefatigable inventor, ever striving for some improvement in any and every technical detail which came within his field of work, but always with an eye to the practical commercial result. His name is associated with the improvement and development of telephony and electrical signalling, with the advance of electric lighting, heating and cooking. He paid great attention to the construction and improvement of electric meters, and of almost every electrical device now in ordinary use.

Mr. Byng was an ardent Tariff Reformer, and author of a work entitled "Protection."

Mr. Byng was a strong advocate of combination and co-operation in industry, and in this connection has done valuable work as chairman of the Manufacturers' Association of Great Britain, in dealing with industrial legislation and procuring modifications in foreign and Colonial tariffs in favour of British manufacturers. He was also a member of the Institute of Electrical Engineers, and many other technical and public bodies. Those who knew him best will miss him most. Truly there are many to mourn his loss.

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Electrical Progress at Home & Abroad.

A Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Some reference was made in my last week's notes to the remarkable conference on Electric Winding which the Newcastle Section of the Institution held at Armstrong College. In spite of the novelty of the scheme—it is probably the first time in the history of the Institution that a conference, as against a discussion, has been held at the meetings—the technical press did not seem to have risen to the sense of its importance, to judge by the scant attention which it has hitherto received. The Newcastle members, however, realised its value, as there was by far a record attendance and the subject proved so interesting that, after a long debate, which, however, was not tedious, it was unanimously resolved at a late hour to adjourn the matter to another meeting. Mr. Wilson's opening remarks covered the subject admirably, his comparisons between the three-phase rheostatic control and the Ward-Leonard direct current control being especially interesting. He raised some very interesting points for discussion, such as the use of double helical gear for transmission, the value of the Koepe pulley, the use of balance ropes, etc.

The Debate.

The subject was well taken up by subsequent speakers, these being representative of the varying points of view from which this subject is regarded. A written communication from Mr. Gerald Hooghwinkel, which was strongly in favour of electric winding, and which drew attention to the good results obtained at the Great Western Collieries, and suggested the turbo-driven combined winder generator and power-generator on the same shaft as arranged by Messrs. Brown-Boveri, was followed by remarks from Mr. W. C. Mountain, who emphasised the advantages of the steam winder as regards simplicity and reliability, as well as low cost of winding coal. This speaker agreed with electric winding where a cheap power supply was available or where the coal was worth 10s. per ton. Mr. Woodyatt, of Messrs. Siemens Bros., spoke in favour of the Ward-Leonard control, and gave some interesting information concerning winders in Durham and elsewhere. He was followed by Dr. Rosenberg, of Manchester, who spoke in favour of the Westinghouse system, and gave particulars of South African winding equipments which had dispensed with the equaliser. He also said that an installation with an Koepe pulley would shortly be running 40 miles from Newcastle. Mr. Gerald Stoney finished the discussion for that evening by drawing attention to the utilisation of the exhaust steam from existing reciprocating winders by means of mixed pressure or exhaust steam turbines, and gave some account of the performance of helical gears on the turbo-boat "Vespasian." Altogether it was an eventful evening.

North-East Coast Institution of Engineers and Shipbuilders.

On Friday, the 25th inst., another meeting of some interest to electrical engineers was held at the Bolbee Hall, Newcastle, when Mr. D. B. Morison, one of the vice-presidents of the North-East Coast Institution of Engineers and Shipbuilders, gave a paper on the "Economical Working of Reciprocating Marine Enignes and their Auxiliaries." Although the subject of condensation and feed heating was treated primarily from the standpoint of the marine engineer, there was much to interest the landsman. For example, the demonstration of the theory embodied in the design of the "Contraflo" condenser, which is now found in so many of our power houses, as regards the withdrawal of air from the condenser, was most interesting, while the description of the various devices adapted to preheating the boiler feed deserved attention. Professor Weighton, and Messrs. Scott Younger, Bruce, Quelch, Westgarth and Gibb afterwards contributed to an excellent discussion.

Electric Advertising in Newcastle.

As is well known, the bye-laws in many large towns are prohibitive in effect as regards electric signs, and Newcastle is a great sinner in this respect. So much is this the case, that it is a matter of great difficulty to get a large outdoor sign installed, as the fees are somewhat heavy. This has led to the development of window and facia signs to a very large extent, and the Newcastle-on-Tyne Electric Supply Company, Ltd., foster this movement with considerable success. Another development deserves notice. Messrs. Pearson, advertising contractors in this city, recently secured a large window on the third storey of one of the central shop premises in the city and arranged an electric lantern of high power inside the room fitted with an automatic arrangement for rotating a series of slides. Each of these slides is a coloured advertisement, which moves into position on the translucent screen, stays a short while, and then gives place to the next. I understand that this form of advertising has proved so popular that the firm are now arranging for a second site in order to deal with the surplus of applications for exhibition.

The Mercantile Dry Dock.

The County of Durham Electrical Power Distribution Company, Ltd., are extending their sub-station at Jarrow in order to deal with a considerable increase to the electrical equipment at the docks of the Mercantile Dry Dock Company. Two transformer chambers are now provided with chambers for the high and low tension switchgear. On the low tension side the capacity of the sub-station will be 1,200 amperes at 440 volts. The two transformer panels for this purpose are manufactured by Messrs. A. Reyrolle & Company, Ltd., of Hebburn.

Newcastle Tramways.

The disastrous effect on the community of the present lock-out may be judged by the last report of the Newcastle Tramways Committee, which shows that the receipts during the past month have dropped by £120. This is the first decrease of revenue for the past twelve months. The men's executive and the Committee appear to be still at loggerheads, as, in response to two complaints received from the former, the Town Clerk was instructed to tell the men that a deputation from them would be received by the Committee provided the Secretary of the Workers' Union was not included. This offer is one which was refused by the men two months ago.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The importance of electricity from a therapeutical point of view is fully recognised in the Birmingham hospitals. A few months ago, the General Hospital reorganised and enlarged its electrical department, which is under the direction of Mr. Hall-Edwards. Shortly after the General Hospital first took up the matter in an experimental way, the treatment of lupus, cancer and other skin diseases by the X-Rays began to attract attention, and a small installation was obtained for the Birmingham and Midland Hospital for Skin and Urinary Diseases. It was soon apparent that the Röntgen rays were a valuable curative agency for the diseases with which this hospital specially deals, and the department, which began in a small room in the basement, was removed to the Board Room, which was enlarged and altered for the purpose. Even this extended installation has soon proved insufficient. The number of patients whose cases were found suitable for electrical treatment either by the X-Rays or the Finsen light apparatus continually increased as experience of these treatments proceeded. Consequently, a new and well-equipped department has been constructed in the basement at a cost of £2,000.

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Linking up the Malverns.

The feeling in Malvern in favour of the supercession of the present motor vehicle service by electrical traction has resulted in a renewal of the scheme tentatively put forward a few years ago. Notice has been given of application to Parliament for a Bill to incorporate a company with power to construct overhead apparatus for railless electric traction in the Urban District of Malvern. The site for the generating station will be in the neighbouring parish of Guarlford. The desirability of linking up the Malverns by a system of electric cars has been discussed on several occasions by the District Council, and this scheme may be regarded as the outcome of those discussions. The scattered districts which surround Great Malvern afford a good field for the operation of an electric system, but the roads present many difficulties in respect of curves and gradients, and it will be interesting to see how far a railless system is adapted to such a case.

Underground Electrical Plant.

An interesting and practical discussion resulted at the recent meeting of the Warwickshire and South Staffordshire Branch of the Association of Mining Electrical Engineers, from the reading of the paper by Mr. R. R. Smith, of the Lancashire Branch, on "Inspection and Repair of Electrical Plant Underground." As a colliery electrical plant has to stand a great deal of rough usage, this question is one to which more attention should be paid than probably in most cases it has hitherto received. Under Board of Trade Regulations, when 200 h.p. or more is being delivered to the buyers to have a competent person in charge underground, and that he shall inspect the plant daily. Mr. Smith's paper insisted that such inspection could only be efficient if it included frequent and thorough examination of the parts in detail. The paper described the system adopted to secure thorough practical inspection at the colliery at which it is employed.

Inspection and Repair.

Generally speaking, the meeting approved of the arrangements described by Mr. Smith, and of some provisional rules for inspection and repair embodied in instructions to power-house drivers and instructions to inspectors and repairers. Some exception, however, was taken to the suggestion that the inspector should stand waiting when a fault occurred while a man was being sent for from the surface. It was thought that, generally speaking, the inspector might just as well complete the repair as waste his time waiting for someone else to be fetched, as, in a large colliery, this might involve the loss of a good deal of working time by the mining hands. It was remarked that a man who is not capable of repairing an ordinary fault could scarcely be considered a competent inspector.

Dangers to Cables.

With regard to falls of roof, the paper insisted as a hard and fast rule upon the current being switched off immediately a fall occurred, owing to the danger among other things of a man sticking his shovel into the cable and getting a severe shock. Some of the members, in discussing this, stated that in some collieries the practice was to protect all cables by placing over them wooden trows, in some cases strengthened with iron strips. The President (Mr. Hall) said that an armoured cable which would sustain damage from a fall could not be considered a good one. He had known armoured cables which had been subjected to very heavy falls indeed, and had not sustained the slightest real damage, even to the outer cover. He agreed with the writer of the paper, however, in regard to the danger to a cable from iron pipes sticking into the ground.

Overflows from Gauge Glasses.

General agreement is expressed with the writer with regard to the stopping up and breakage of gauge glasses and the trouble arising from the overflow of oil over the lip of the bearing into the motor, and his suggestion that the trouble was due to suction produced by the sudden circulation of air was endorsed. His remedy, the result of experiment, was to cut air-ways in the leather joints of the lids, and this was approved, although several members thought that iron pipes should be used wherever possible in preference to glass, owing to the difficulty of making satisfactory joints for the latter.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

There is a continued steady improvement in the state of trade here, and electrical firms are getting their share of the work. In fact, several firms are now beginning to complain of too many orders for their present equipment to cope with. The fear that trade may drop off again deters such firms from putting down extensions until they become quite unavoidable. The other day the Local Government Board held an enquiry into the Manchester Corporation's application to borrow £30,000 for extensions to the electricity station at Stuart-street, by the addition of another turbo alternator, etc., to meet the growing demand for power for industrial works and for suburban lighting. The officials of the local ratepayers' association were busy making objections and generally endeavouring to show that the department's policy was wrong because large firms were supplied at a low rate, the trams paid cost price, and there was not enough placed to reserve. The whole cause of the opposition seems to be because the gas committee think the electricity department is "slowly murdering" theirs! What else do they expect? It is a pity the ratepayers' association have nothing better to do than interfering with the paying departments of the Corporation. If they want an excuse for their existence, there are many leaks they might stop elsewhere, where technical knowledge is not required to understand the problems involved.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The detrimental effects of the boilermakers' lock-out are spreading to all branches of industry in Scotland. So far as shipbuilding firms are concerned orders upon local supply houses for lamps and fittings are practically stopped for the time being. On the other hand, various local supply houses are taking the opportunity afforded by the Glasgow Electricity Department's new heating tariff to draw the attention of domestic consumers especially to the merits of radiators, irons, hot plates, vacuum cleaners, etc. The General Electric Company, with their customary promptitude are the first on the field with a carefully drawn circular letter addressed to likely customers and calling attention to their special display of radiators in their show rooms in Waterloo-street.

Edinburgh Electricity Department Surplus.

The Electricity Committee of Edinburgh Corporation have wisely retained their surplus of £7,300, from last year's operations, for the purposes of the Department which earned it. The re-arrangement of the plant at Dewar-place in connection with the condensation scheme will involve the scrapping of part of the present plant and its replacement by newer and more economical machinery, and it was suggested that the surplus should be devoted to that purpose. It was ultimately resolved that application should be made to the Secretary for Scotland for consent to borrow £37,000 to cover new and additional expenditure in connection with the condensation scheme at Dewar-place; that the sum of £8,000 required for the replacement of the plant to be scrapped at Dewar-place be met out of revenue: and that the surplus of £7,300 be retained in the hands of the Committee until May 15, 1911.

The New Heating Rate in Glasgow.

As stated in these columns last week, the Glasgow Corporation are now giving heating supplies to domestic consumers at practically 1d. per unit off the lighting circuit. It may be interesting to note that the method of ascertaining the maximum demand is based on an elaborately calculated series of averages covering tenement houses and flats ranging in size from 1 room and kitchen to 7 rooms and kitchen. It is found roughly that one room and kitchen houses will be asked to consume 30 units at 3d. before getting on to the penny rate: 2 rooms and kitchen, 50 units; 3 rooms and kitchen, 100 units; and 4 rooms and kitchen, 200 units. Large private houses are to be dealt with individually. The introduction of the new system

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has called forth shoals of enquiries regarding the possibilities of electric heating, and, strange to say, the interest thus created is extending to other parts of Scotland, as is evident from the number of radiators which local houses are placing in Greenock, Paisley, Edinburgh and Dundee.

Clyde Valley Company and Gambuslang.

The negotiations which have been going on for some time between Lanarkshire County Council and the Clyde Valley Electric Power Company with regard to the latter taking over the County Council's electricity undertaking at Gambuslang, have fallen through. The Committee of the Council dealing with the matter were dissatisfied with the proposed tariff of the Clyde Valley Company, which is said to have been 3d. higher than the charge under the existing auspices.

Scottish Exhibition of 1911.

The arrangement of details in connection with the forthcoming exhibition of National History, Art and Industry, to be opened at Glasgow by H.R.H. the Duke of Connaught in May, 1911, are now well forward. The "Kelvin" Hall, which is to house the electrical and general engineering section will prove of great interest to electrical engineers. Special attention is being devoted to general electric lighting and distribution of electric power. Artistic electric illumination, aided by the adjacent river Kelvin, the trees and natural undulations of the grounds, are being carried out on an elaborate scale and in a novel manner. A special feature will be an electric fountain driven by electric turbo pumps forcing the water through the jets and nozzles at the rate of 400 gallons per minute and giving a column of water 40 ft. high. The fountain basis, 50 ft. in diameter, will have its colour effects supplied by 8 large electric projectors with film carriage equipment fitted beneath the fountain, and giving over 20,000 c.p. A substantial building in the Scotch Baronial style is being provided to house the exhibition electric station, which will include rotary converter and transformer plant, and high and low tension switch gear, the total capacity being 3,000 h.p. Lighting will be by means of some 400 arc lamps and many incandescent electric lamps for the general lighting of the buildings. The lighting installation contracts have been divided and placed with the following local contractors: Andrew Hutcheson, Bennett & Rutherford, Primrose & Primrose.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The Chief Police Office has issued some new regulations with regard to the lighting of garages. The lighting must be done with incandescent electric lamps heated in vacuo and provided with a tightly closing outer glass, or by means of outside lights having no interior with the interior of the garage. In other respects the rules of Verband Deutscher Elektrotechniker with regard to high-tension currents must be observed. When the use of wall plugs is unadvisable they must be well made of suitable materials and must be at least 5 ft. from the floor. Portable lamps must be on the Davy mine lamp principle.

Suburban Electric Trains.

In suburbs where considerations of expense do not permit electric traction being removed from the ordinary traffic by tunnels, it has been recommended by Herr. Stahl that a part of the middle of the wide thoroughfares should be reserved for electric trams. Instances are given of the success the adoption of this plan receives in streets 80 ft. wide from house front to house front, where the ordinary traffic is in no way impeded by the rapid service of trams in the reserved portion of the roadway.

German Street Railways.

The following table gives some interesting statistics of some of the chief German electric tramlines in 1909:

Town.	Length of line.	Passengers carried.	No. of vehicles.
Dresden ..	96 miles ..	100 million ..	479
Leipzig ..	72 ,, ..	104 ,, ..	472
Chemnitz ..	23 ,, ..	23½ ,, ..	—

Testing the Electrical Conductivity of Waste Lyes and Water.

A portable apparatus has been put upon the Berlin market by Herren Bosse & Company for determining the conductivity of natural water and waste lyes. It depends on Kohlrausch's bridge-method. The current is supplied by two small dry cells and is converted into an alternating current by a differential buzzer, an induced current being produced in a coil at a fair distance from the latter. The buzzer-interrupted consists of two coils with resistances of one and ten ohms respectively, and its working is not affected by changes in voltage. The apparatus includes a liquid resistance and the compensation resistance is provided by two bifilar-wound coils, one of 10 and one of 100 ohms.

German Gas and Electric Companies.

The statistics for 1909–10 are now to hand in respect of 118 public companies. The total capital represented increased from 289 million marks in 1908–9 to 322¾ millions. The increase in the dividends paid was from 21·2 to 25·1 million marks, showing an increase of the average dividend from 7·3 to 7·8%. Of the 118 companies, 8 only worked at a loss, as against 12 in the preceding financial year, and 9 firms, although not losing, paid no dividend. The capital of the losing concerns was 1,826,000 marks as against 4,784,000, and the losses fell from 1,139,000 to 736,000 marks. Forty-eight companies paid dividends not exceeding 4%. They represent 32¼ million marks of capital. On the other hand, 23 companies representing 201 millions paid 8% and upwards. It is an old story that nothing succeeds like success, and that the tendency in modern times in all civilised countries is to concentrate trades in a few hands.

The net profit of Maschinenfabriken Oerlikon fell from 439,338 marks in 1908–9 to 370,535 in 1909–10, but the same dividend, 4% on the eight million marks of share capital will be paid. Affairs are improving, however, and the directors are confident of recovering the lost ground at least.

Electrically-Driven Hanging Railways.

In a lecture delivered at Dusseldorf before the fifth international of mining and geological engineers, G. von Hanffstengel maintained that, for straight long distances the rope line was far cheaper for the same amount of transport than an ordinary railway. While the running expenses of the latter increase rapidly with increase of distance, those of the former are practically constant for distances under 7 miles, and increase but slowly when that limit is passed. For transmission within the area of a works, however, the electric hanging railway is preferable. For carrying comparatively small loads over short distances it is far more economical than the mechanical overhead line up to a carrying work of 40 to 50 tons per hour. On the other hand, if many vehicles are required the cost of the electric line begins to mount up alarmingly, for the single electric vehicles are expensive. Rope lines and electric hanging lines can often be used together with advantage. For example, for taking charges to the top of blast furnaces and foundry cupolas it is a good plan to use the former, for the horizontal part of the journey, and the latter for the inclined parts of the route, and also for vertical parts of the lift.

Cost of Electric Ploughing.

A large number of experiments with the latest type of electric motor hauled ploughs has given some statistics as to the costs of the operation, which were badly wanted. The expenditure of electric energy per morgen (3,000 square yards) for ploughing an average soil to a depth of about 9 in. is about 15 kw. hours, or 19 in wet weather. Increasing the depth to 16 in. increases the consumption to 24 watt hours. Thirty-six morgen (roughly 20 acres) can be ploughed in 24 hours in favourable weather and 30 morgen in bad weather. The travel of the plough from side to side is reckoned at about 1,000 ft. and the time at 3 min. in each direction.

Underground Railways of Berlin.

The subterranean lines of Berlin are shortly to be almost entirely worked by electricity. Possibly next spring will see the completed installation and electric working.

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New German Paper.

An advance copy of the "Technisches Welt-Register" has been issued. The regular issue, however, is to commence next spring. The paper contains a list of publications arranged in the alphabetical order of the countries, another index relating to trades, extracts from articles mentioned in journals arranged trade by trade, and a catalogue of the journals considered divided alphabetically according to countries. The subscription price for Germany is 24 marks per annum.

Company Notices.

The net profits of Hartmann & Braun A.G., Frankfort o/Main, fell from 512,864 marks in 1908-9 to 302,705, and the dividend has fallen from 11% to 8%. Nevertheless the outlook is brighter now.

The Stattiner Elektrizitats Werke pays 7% on its capital of 5 millions. The net profit has increased slightly this year from 388,891 to 389,069 marks.

The Kabelwerk Rheydt A.G. paid 8% for 1908-9, and is paying no dividend for 1909-10. The net profit is 10,614 marks and will be carried over. The capital is $3\frac{3}{4}$ million marks.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The standardisation of electrical practice in mines is a matter in which we are in this country, it would appear, a good way behind England. It is certainly a fact that while mine managers have been ready enough to realise the importance of electricity in mining operations, they have too often permitted installations to be made without the slightest reference to the peculiar conditions which may make the wiring a source of perpetual danger. The chief source of the evils so far encountered would seem to be due to the fact that some of the managers conclude that once the wiring is done there is no longer any need to employ an electrician, and still less to have a regular periodical inspection. Nearly two years ago this subject received special attention at the hands of the American Mining Congress, and Dr. E. B. Rosa, of the Bureau of Standards at Washington was placed at the head of a committee charged with the full investigation of the subject. This committee has not yet concluded its labours, but the Bureau has just published a circular summarising the result of its inquiries so far as they have gone. This takes the form of a set of rules which, if not yet covering the whole ground, affords an excellent basis for a beginning in the direction of standardisation. One of the most important of the proposed rules is that every mine which is electrically equipped shall put the installation under the charge of a properly qualified electrician, and another is that the Government Inspectors of Mines shall include in their staff trained electrical inspectors who have passed a special examination in this branch of work.

104,000 Volt Switch.

The Bowie Company's Kilarc switch, to which reference was made in these Notes a few months ago in a description of the Bay Shore sub-station of the Sierra and San Francisco Power Company, has just passed through with complete success a test of a remarkable character. The United Railways of San Francisco are supplied with power transmitted at 104,000 volts, and the switch, through which passes one of the incoming power lines, was built to handle a minimum of 10,000 kw. and to open under load. In the test referred to the line was loaded with an induction current of 52 amperes on the high-tension side, for over 9,000 kw.-amperes. This load was handled by the Kilarc switch without the slightest difficulty and without causing any voltage disturbance to the system. The "Electrical Review," of Chicago, in commenting on the test, observes that the principle involved has been the subject of considerable discussion among electrical engineers, most of whom maintained that the opening of air switches would set up serious oscillations in the line. The "Review" suggests that this opinion is due to the use of air-switches of improper design, where the break in the circuit occurs in an arc which is ascending in nearly a vertical direction, and where the rupture of the arc will occur in such a manner that the ascending column of heated air will cause the arc to reform. In horn switches of the design shown, it is a practical impossibility for the arc to break in such a manner, since the tendency for the arc to rise is so strong, that with proper inclination of the horns, the break will be substantially horizontal, and in such a manner that there is no possibility of reformation of the arc, and hence there will be no surging. The results of extended experience with these switches have shown that they will operate without causing material disturbance of voltage, and in this respect are considerably superior to oil switches, owing to the high resistance of the long arc, which greatly weakns the current before the final break.

Gradeless Electric Railway.

An overhead electric railway for mineral transport has been constructed at Blossburg, in Pennsylvania on a somewhat novel principle. The object of the line is to connect the coal mines with the nearest railroad siding, and it has been constructed without grading. The gauge of the line is 2 ft. 6 in. and the rails are supported on single iron posts in a concrete foundation, the height of these posts varying, according to the elevation of the ground traversed, from a few feet to upwards of 30 ft., the track itself being perfectly level all the way. Two electric motor cars and four trailers form the unit of service, and their combined capacity is 8 tons. Current is taken through a V-shaped groove on the underside of one of the rails, and the trains can either be operated by a motor-man or automatically by an attendant at either end. At an average speed of four miles an hour the capacity of the train is 1,000 tons of coal per day. The train, track, and power station were supplied by the Automatic Transportation Company, of Buffalo, and the installation has proved a remarkable success.

Electric Power for Oil-pumping.

Throughout the oil wells of California, whence 50,000,000 barrels are pumped annually, electricity is rapidly superseding other forms of energy for pumping owing to its economy, convenience, small initial cost, and cheapness of operation. In actual test in the oilfields it is found that the annual repair bill of a motor is less than 5% of its cost, as against 9% for steam power and 15% for gas. Neither fuel nor water are required, and the assistance of a body of stokers and enginemen is wholly dispensed with. It is true that where natural gas is found some mining companies are still using gas engines, but they are finding that in lubricating oil alone their plant costs as much to operate as electric motors of equal capacity, and by degrees all are coming round to the use of electricity. An important factor in these developments has been a special adaptation of the three-phase induction motor to meet the difficult conditions of oil pumping. The motor employed is of the polyphase induction type with form wound rotor, having three collector rings and external controller and resistance. Variable speed is obtained by varying the external resistance in the rotor circuit by a cylinder controller much like that used in street car service. One recent test showed that the stroke of the pump can thus be varied from 15 to 27 per minute as required and also that the down stroke was much faster than the up, the motor speed varying from 210 to 470 r.p.m. when pumping 15·2 strokes per minute to from 495 to 625 r.p.m. when pumping 26 strokes per minute. The motors may be either back-geared or belted to a counter shaft and thence belted to the band-wheel. The actual horse-power required for pumping varies from 5 to 8, and for pulling out rods and tubing from 30 to 50, depending upon the depth of the well. The most practical installation is a motor that will take care of both pumping and cleaning, a requirement met by the Y-delta motor. With line voltage of 440 and motor connected in delta full line voltage is impressed on the coils of the motor. If the motor coils are Y-connected the voltage on each coil is 57·7% of the line voltage or 254 volts. As the torque of a motor varies approximately as the square of the voltage a 440 volt delta connected 20 h.p. motor gives 6·67 h.p., when Y-connected. The power factor and efficiency is practically the same when running at full load on the Y-connection as when running full load on the delta-connection, the control apparatus having

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the same effect in either case. The change from Y to delta connection is accomplished by the use of a triple pole, double throw switch usually mounted on the motor frame.

Current Items.

A private telephone exchange is operated by the Georgia Railway and Electric Company, Atlanta Ga., to keep in touch with the inspectors throughout the sytem. As the inspectors are scattered over a large territory it is very desirable for the headquarters to know just where they are and when to expect them.

It is reported that the Los Angeles Railway Corporation, which recently succeeded the Los Angeles Railway, has taken over all the lines of the Pacific Electric Railway, Los Angeles, Cal.

The Pennsylvania Tunnel under the Hudson River will be opened November 27, when 300 steel cars will be put into operation. The Pennsylvania officials have placed an order with the U.S. Light and Heating Company, of Niagara Falls, to equip 300 steel cars with electric lights. Electricity is the only thing that can be used to light the cars.

The Hudson and Manhattan Railroad is now operating more than 2,200 trains a day in the tunnels under the Hudson River between New York, New Jersey, and Holboken. This is the largest number of trains operated in one day on any double-track railroad in the world.

The Public Service Commission of the First District of New York has accepted the offer of the Interborough Rapid Transit Company to operate the Steinway Tunnel under the East River between the Grand Central Station and Long Island City, in return for permission to third-track the company's elevated lines.

STAMPINGS AND DROP-FORGINGS.

The Electric Drive.

A trial of the electric motor on one or two machines resulted recently in the partial electrical equipment of the works of the well-known firm of Thomas Smith & Sons of Saltley, Limited. This firm is, perhaps, the largest of its kind in Great Britain, making all classes of stampings and drop-forgings for motors, agricultural implements, guns, ship builders, and machine makers generally. Another branch of the firm's work, started over 62 years ago, is the manufacture of edged tools and hammers of solid steel, etc., etc., for every known requirement. The plant displaced by the new method of driving consisted of one 100 h.p., 40 r.p.m., beam engine, a 30 ft. by 8 ft. 6 in. Lancashine boiler, two 14 h.p. and one 8 h.p. gas engines running off the town mains. These were replaced by 11 motors, varying in capacity between 3½ and 45 h.p. and at a speed of 710 r.p.m., together with the necessary cables, switchboard, etc. Two gas engines and two steam engines are still in use.

The electrical supply is obtained from both the Bordesley and Saltley sub-stations of the Birmingham Corporation Electric Supply Department, and is fed into the works from two supply mains at 5,000 volts, 3 phase, 25 periods, by three-core, paper-insulated, lead-covered cables laid underground in earthenware troughs, to the high-tension, 3-panel, iron-clad switchboard in the sub-station, covering the small space of 15 ft. by 12 ft. and enclosed on two sides by expanding metal screens and on the other two sides by existing walls. Entrance is effected by an expanding metal door (which is kept locked) on the ground floor, as seen in the background of Fig. 1. The switchboard is of the standard type used by the Birmingham Corporation Electric Supply Department, the outside panels being connected to the incoming feeders and the central one to the customers' circuits, arrangements being made for running off either supply. On each of the incoming feeder panels are two potential indicators and an oil switch. On the outgoing panel are fitted an ammeter, two potential indicators, a wattmeter, and an oil switch. From this panel the supply is taken by three single-core, rubber-insulated, lead-covered cables to the main oil-switch, mounted in a stone cubicle, from which it is led by three single, rubber-insulated cables to a 200-k.v.a. 5000–440-volt, oil-cooled transformer; and then by three rubber-insulated, single-wire armoured cables supported on porcelain insulators, mounted on the wall, to the low-tension panel containing ammeter, voltmeter, and porcelain fuses for each of the five outgoing circuits which are fed to the distribution boxes in different parts of the works.

The steel used for the manufacture of the various tools is brought to the works in bars and cut to the lengths required before being heated in the furnaces, preparatory to being stamped out in the drop stamps to the particular shapes desired. A battery of 4 to 7 cwt. stamps are operated by a 45 h.p. motor. This motor is belted to line shafting running along the top of the stamps on which are fitted the pulleys, operating them. A steel band is attached to the weight (*i.e.*, to the top half of the die), passes over the pulley, and is joined to a rope of sufficient length to allow the man operating the stamp to catch hold easily. By pulling the rope the friction between the band and the pulley lifts the weight, and the weight being released, the weight falls on the heated metal. This operation is repeated a number of times (according to the weight of the

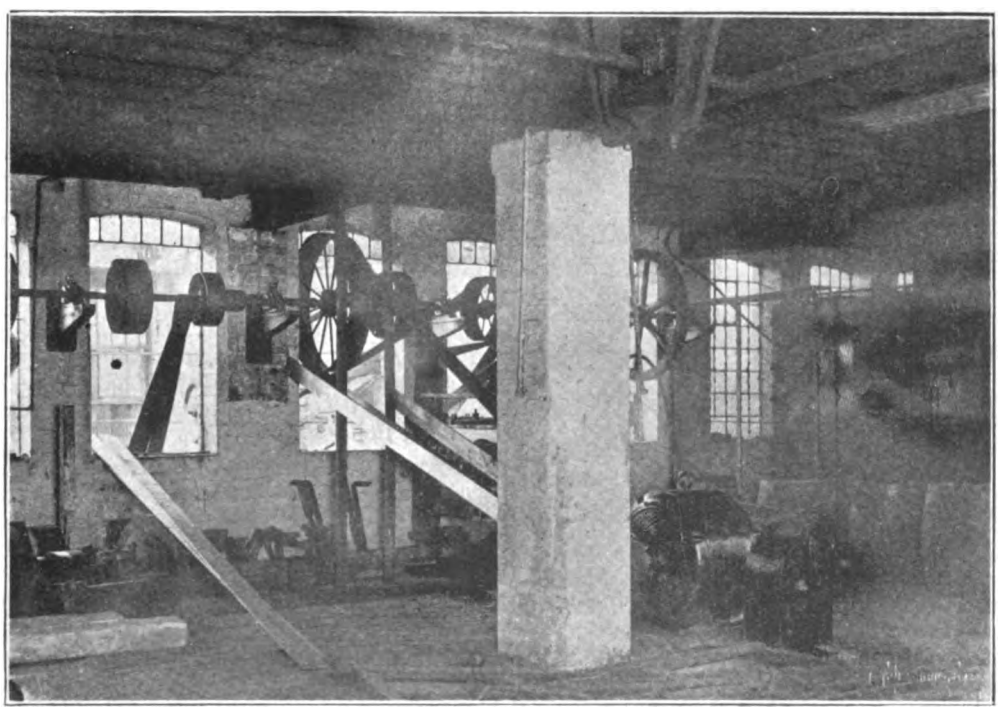

FIG. 1.—20 H.P. MOTOR DRIVING SHAFTING FOR STAMPS AT MESSRS. THOS. SMITH & SONS, LTD., SALTLEY.

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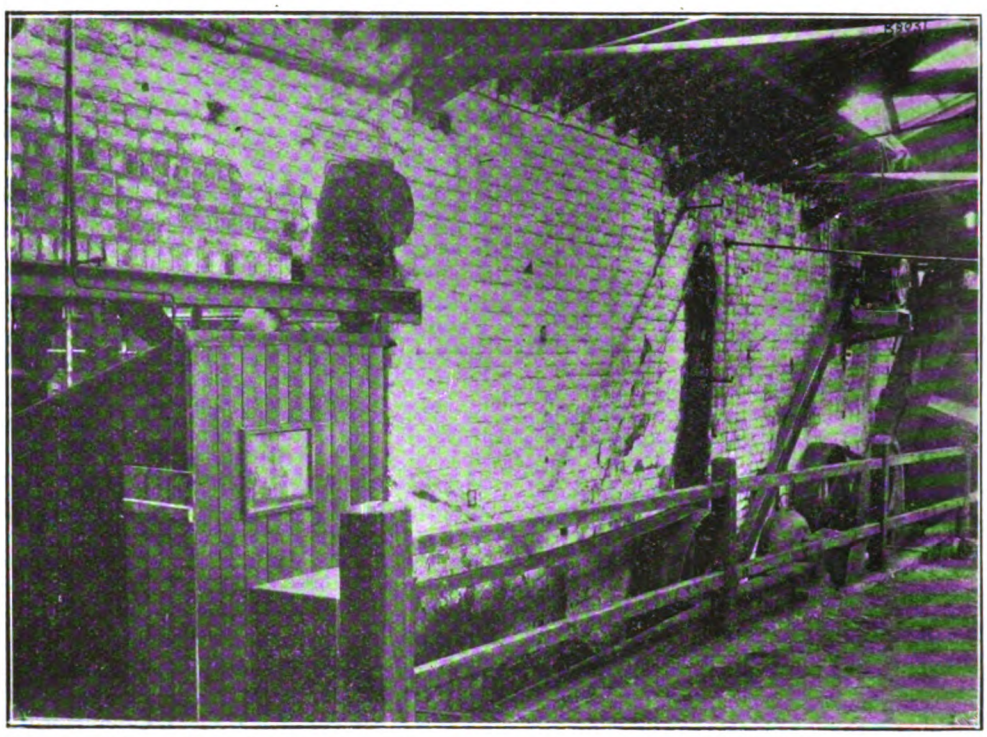

FIG. 2.—10 H P. TYPE "C.B." MOTOR DRIVING BLOWER AT THOS. SMITH & SONS, LTD., SALTLEY.

top die, the distance it falls, and the heat of the metal), until the desired forging is obtained. The furnaces are used for heating the metal before it is taken to the stamps. The furnace fires are blown by a 10 h.p. motor-driven fan. This fan is illustrated in Fig. 2, which shows in the foreground a wooden shed containing the 45 h.p. motor mentioned above, and, in the background a shed with a second 45 h.p. motor driving a group of three stamps, the furnaces in connection with which are blown by a fan

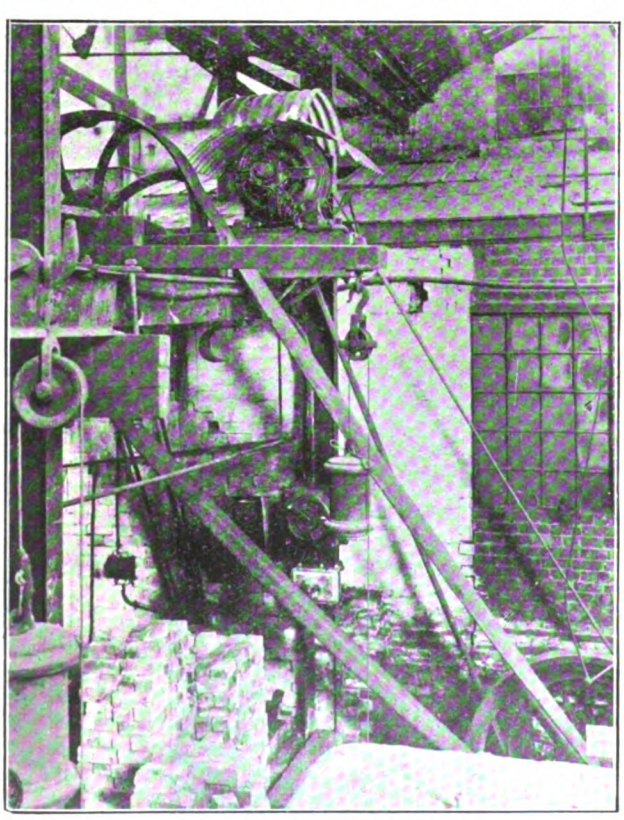

FIG. 3. 20 H.P. TYPE "C.C.B." MOTOR DRIVING A SET OF STAMPS AT MESSRS. THOS. SMITH & SONS, LTD., SALTLEY.

driven by a 7½ h.p. motor. Fig. 3 shows a 20 h.p. motor mounted on the framework of the stamps, and driving three sets through belting. A fly-wheel is used on the countershaft as a pulley and is mounted in a portion of the space which formerly contained the displaced large boiler. In Fig. 1 can be seen a 25 h.p. motor driving two large American board stamps and two power presses, through belting.

From the stamps the forgings are taken to the emery wheels, driven by a 7½ h.p. motor. The edged and other tools are taken to the grinding mills, containing six large wet running stones driven by a 15 h.p. motor. The 7½ h.p. motor which drives the emery wheels also drives the exhaust fan used to carry the dust from the wheels to the dust settling tanks. It is interesting to note that the motor is so mounted as to occupy no useful space.

The shop in which the polishing of the tools is carried out is operated by a 10 h.p. motor, mounted on the ceiling. This motor drives seven polishing machines, the exhaust fans used in connection with these being operated by a 4 h.p. motor. The handles for the different tools, such as hammers, etc., are made on the premises in the wood-working department, which is sectionised and is driven by two 5 h.p. motors.

The whole of the electrification of these works has been carried out by the British Westinghouse Electric and Manufacturing Company, Limited, to whom we are indebted for the above particulars.

DIARY.

MONDAY, DECEMBER 5.

ROYAL INSTITUTION, ALBEMARLE-STREET.—At 5 p.m., special meeting.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, at 8 p.m., Mr. C. R. Darling on "Industrial Pyrometry" (III. Cantor Lecture).

TUESDAY, DECEMBER 6.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Section.)—At the Physical Laboratory, Manchester University, at 7.30 p.m. Dr. E. Rosenberg on "The Methods of Breaking in Electric Winding Engines."

WEDNESDAY, DECEMBER 7.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Bride-lane, E.C., at 8 p.m., Mr. J. B. C. Kershaw, F.I.C., on "Practical Notes on the Working and Control of Steam Boilers."

ELECTRICAL COMMITTEE.—In the Lecture Theatre of the Institution of Electrical Engineers, at 8 p.m., Conference, open to all members of the electrical industry, on the advisability of undertakers under the Electric Lighting Acts being empowered to wire premises and to supply electrical appliances. Cards from Mr. R. B. Matthews, Bank Buildings, Kingsway, W.C.

INSTITUTION OF ELECTRICAL ENGINEERS (Yorkshire Local Section).—At the University, Sheffield, at 7 p.m., Mr. A. J. Oridge on "The Cost of Cooking and Heating by Electricity."

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

ACTON.—A referendum was taken as to the sale of the Council's electricity undertaking to the Metropolitan Electric Supply Company. There were 2,245 votes for and 2,043 against, but only about a third of the ratepayers voted. The Council propose to carry the project through, but the Bill in Parliament will be opposed.

BELFAST.—The demand for electricity has necessitated the taking in hand of main extensions in various streets.

BLACKPOOL.—The Corporation propose adopting a Municipal electric time service. About 100 clocks will be placed in different parts of the town, controlled electrically from a master-clock at the Town Hall.

BOGNOR.—An effort is to be made in the Town Council to rescind the proposal to apply for a Provisional Order under the Electric Lighting Acts.

BRIGHTON.—On the suggestion of Mr. John Christie, the Borough Electrical Engineer and Manager, it has been decided that any consumer requiring electricity for special illumination purposes during the Coronation week, June 17 to 26 inclusive, be supplied through a separate meter at a flat rate of 1d. per unit, plus a connecting fee of 5s., provided the supply can be taken off the existing service. In the event of a special service having to be laid for the purpose, the consumer to pay the whole cost and make the necessary arrangements.

COSELEY.—At Coseley Parish Church, Staffordshire, the Vicar, the Rev. W. Spencer, has had erected a wind turbine, 18 ft. in diameter, in a disused colliery estate adjoining the churchyard, and has succeeded in installing a wonderful wind-driven electric generating plant, which not only illuminates the church and the vicarage, but also provides current for blowing the organ.

EDINBURGH.—The Electric Lighting Committee have recommended the Town Council to apply to the Secretary for Scotland for consent to borrow £37,000, being the amount of new and additional expenditure in connection with the condensation scheme at Dewar-place; that the sum of £8,000 required for the replacement of plant to be scrapped at Dewar-place be met out of revenue; and that the surplus of £7,300 be retained in the hands of the committee until May 15, 1911.

HECKMONDWIKE.—Mr. H. R. Hooper, Inspector of the Local Government Board, adopted the unusual course of adjourning a public inquiry *sine die*. The Corporation applied for powers to borrow £24,159 for the electricity works. Of this sum, the inspector pointed out, apparently about £20,000 had already been spent beyond the sums sanctioned, and advances obtained from the bank at 3½ per cent. The inspector was not satisfied with the replies as to when the various items of expenditure had been incurred, and so adjourned the proceedings.

HORSHAM.—Mr. J. B. Morgan has issued the Electricity Departments accounts for the year ending March 31. The income was £4,352, including £1,417 for public lighting. The total expenditure was £2,279, but interest and repayment absorbed £2,031. There was also a debit balance of £1,924 from 1909. There is thus an improvement, though not a big one, due to the increased output. The total costs have been reduced from 4·18d. to 2·31d. per unit, while the price paid by consumers has fallen from 5·84d. to 4·86d. per unit.

IPSWICH.—The Town Council are applying for sanction to borrow £4,050 for extensions to their electric supply undertaking, and to instal flame arc lamps for lighting a portion of London-road.

LLANWDDYN.—At this village, on Lake Vyrnwy, the Liverpool Corporation have placed the light in the dwellings of their officers and workmen connected with the great reservoir, as well as in the workshops and institute, and it is now to be extended to the thoroughfares of the village.

MALDEN.—The Wimbledon Corporation will apply for a Provisional Order for the electric lighting of the Maldens and Coombe.

PICKERING.—The Board of Trade have revoked the Pickering Electric Lighting Order, 1901.

SOUTHAMPTON.—New rules have been formulated as regards "free wiring" and the supply of electrical appliances under the Southampton Corporation Act, 1910. Wiring is to be carried out by local contracts on a scale to be graded according to premises, and consumers will pay cost plus 20 per cent., the amount to be divided into 12 quarterly payments. Consumers will have to buy lamps, shades and fittings outright. Motors will be supplied at a rental of 20 per cent. on prime cost up to £100, and by arrangement for higher priced machines. Radiators will be charged for at the rate of 10s. per annum.

OVERSEAS.

BRAZIL.—The Minister of Viação e Obras Publicas will spend 110,000 milreis on the erection of telegraph lines between Porto Martinho and the Paraguayan frontier, and between Goyaz and Boa-Vista.

STOCKHOLM.—H.M. Minister at Stockholm reports that the new electric works at the Trollhättan Falls have been opened. When the eight turbines and generators are constructed, for which the water supply is ready, the amount of electrical energy available will be 80,000 h.p. It is calculated that by the construction of new works on the river and the lake 180,000 h.p. can be obtained. Many of the towns and villages in the neighbourhood of the falls are supplied with power; in the immediate neighbourhood, mills, etc., are already prepared, as well as the electric smelting apparatus installed by the Swedish Iron and Steel Institute (see p. 35 of the "Board of Trade Journal" of July 7 last), and preparations are also being made with a view to the electrification of the railway. It appears that at present the actual demand does not exceed 10,000 h.p., but it is expected to be much increased in the near future, though not above 30,000 h.p. It seems likely that electrical energy will be used in small quantities for local industries and agriculture, as is the case in Denmark. The budget of the State water and electric works at Trollhättan for 1911 estimates the receipts at £57,000 and the expenditure at £24,000, leaving a surplus of £33,000 on a total capital expenditure of £850,000.

TRACTION.

HOME.

BRIGHTON.—The Corporation are playing a rather astute game. While reserving their right to oppose any Bill in Parliament for the electrification of the proposed tramway between Aldrington and Shoreham, they have come to terms as regards the supply of electricity should the scheme be carried out.

MALVERN.—A company is to apply for powers to run cars on the trackless trolley system in this district.

PURLEY.—The Railless Electric Traction Company will apply for powers to run cars on the trackless trolley system from here to Caterham and Merstham. This would place the heart of Surrey in direct tramway communication with London, by way of Purley to Croydon, and Croydon to Norbury, a terminus of the L.C.C. tramway system.

SCARBOROUGH.—In the police court an application was made for a summons against the Scarborough Street Tramways Company with a view to the appointment as receiver of Mr. Charles H. Jones, secretary of Edmundson's Electricity Corporation, Limited, of London, on whose behalf the application was made. The receiver was wanted on account of arrears of interest under an indenture of mortgage dated February 10, 1910, made between the company and the Corporation. The application was granted, and subsequently Mr. Jones was appointed receiver.

STOKE-ON-TRENT.—The Board of Trade held a local inquiry into the application of the Potteries Electric Traction Company for permission to abandon the construction of the following sections of the light railways which they obtained powers to construct under the Orders of 1897 and 1902: (1) From Newcastle to Trent Vale; (2) from Hanley to Bucknall; (3) from the present terminus at Meir to Catcham's-corner, Blythe-bridge. The application was opposed by the Stoke-on-Trent Town Council, the Newcastle Town Council, and the Stone Rural District Council. The lines which the company wish to abandon would cost £43,000 to construct, and their grounds for abandonment were chiefly that the undertakings would not be commercially remunerative.

OVERSEAS.

BILBAO.—The Compania del Tranvia Urbano de Bilbao, have applied for a concession for the construction and working of an electric tramway (for the carriage of goods) in Bilbao.

BRESCIA.—The Italian Government have granted a concession to the Societa Electricita Bresciana for the construction and working of a system of urban electric tramways in the town of Mantua.

NAPLES.—The Society of Tramways of the Province of Naples have been granted a concession for the construction of an electric tramway from Aversa to Casal di Principi.

STOCKHOLM.—Considerable progress is being made with the railway to the Porjus Falls in North Sweden, and it is expected that hydro-electric work at the falls will be begun next spring.

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COMPANIES' MEETINGS AND REPORTS.

BUENOS AYRES LACROZE TRAMWAYS.

The report of the Buenos Ayres Lacroze Tramways Company, Limited, states that the gross receipts for the year to June 30 amounted to 3,820,500 dollars (Argentine paper), an increase of 519,280 dollars, while the working expenses, including taxes, totalled 2,320,300 dollars (Argentine paper), an increase of 341,700, dollars. The percentage of working expenses has been 60·70 per. cent., as against 61 per cent. in the previous year. A sum of 355,110 dollars (Argentine paper) has been transferred to the repairs fund, and it is now proposed to add 47,500 dollars to the reserve account. The shareholders receive 750,000 dollars, as against 500,000 dollars in respect of 1908-9, and there then remains a surplus of 3,152 dollars (Argentine paper) to be carried forward.

DOUGLAS SOUTHERN ELECTRIC TRAMWAYS.

The directors report that the company's season consisted of 133 days, against 125 days last season, and the mileage run was 36,739·54, as against 36,570·32 last year. The total receipts are £4,812, or £22 over the receipts of last year. The weather during August, which is the most important month, was wet and cold, and this, combined with an unsettled state of trade, had an adverse effect upon traffic. The passengers carried were 196,088, as against 194,826 last year, and the tolls payable to the Douglas Head Marine Drive, Limited, amounted to £802, and a commission of £240. After deducting these amounts and adding sundry small receipts, the total is £3,778, as against £3,758 last year. The net profit for the year is £1,482, as against £1,522, which, added to the £153, balance from last year, gives a disposable balance of £1,636. This enables the directors to recommend a dividend of 5 per cent. upon the preference shares, absorbing £1,928, and leaving £337 to be carried forward. With the exception of £37, there are no debts, debentures, mortgages, or other incumbrances whatever upon the company's property. The receipts in July were £1,221, and in August £2,334. The dividend is the same as last year—that is, 2 per cent. below the full rate. The last dividend on the ordinary shares was $1\frac{1}{4}$ per cent. for 1905-6.

ADELAIDE ELECTRIC SUPPLY.

The annual report for the year ended August 31 states that the profit and loss account shows a credit balance for the year of £42,238 17s. 7d. After payment of the dividend on the preference shares for the half-year ended February 28, 1910, there remains, including the amount carried forward from the previous year, an available balance of £38,551 6s. 10d., which the directors recommend should be applied as follows:—To dividend on 30,000 6% preference shares for the half-year ended August 31, 1910 (paid on September 1, 1910), £4,500; to dividend of 7% on 30,000 ordinary shares for the year ended August 31, 1910, £10,500; to bonus of 2s. per share on 30,000 ordinary shares for the year ended August 31, 1910, £3,000; to transfer to depreciation account, £1,000; to transfer to dividend equalisation account, £15,000; to balance carried forward, £4,551 6s. 10d.; total £38,551 6s. 10d. During the year a further sum of £38,389 14s. 3d. was expended on capital account in the provision of additional land, buildings, plant and mains. The company's mains have now been carried into the majority of the residential and manufacturing districts surrounding the city of Adelaide. The directors propose to continue their policy of energetic development. With a view to providing the necessary funds, the directors will submit a resolution to increase the capital of the company by £100,000 by the creation of 20,000 further ordinary shares of £5 each, and will ask for authority to issue such shares, as and when they think proper, for the purposes of the company. The shareholders will also be asked to pass a resolution to alter the articles of association so as to authorise the directors to send dividend warrants to the shareholders by post. The temporary supply of power to the Adelaide Municipal Tramways Trust has been continued satisfactorily during the year. It is anticipated that the Trust will be in a position to generate their own supply early in 1911, when the company's revenue from this source will cease. The directors again recommend that a portion of the profits be transferred to a dividend equalisation account.

OXFORD AND DISTRICT TRAMWAYS.

The report of the directors stated that in their report issued in August of last year, they referred to the fact that the Oxford Electric Tramways, Ltd., in agreement with the Oxford City Council, had applied to Parliament for an extension of period for the electrification of the tramways and the alteration of the system. It was originally provided that the Dolter Surface Contact System should be installed in this City, but in January of 1909 the City Council resolved that the Dolter system had not been worked satisfactorily, and by the Act of Parliament above referred to, the system was changed to the overhead or trolley system in the outskirts and certain lengths of conduit in the centre of the City, and the period of construction was extended for three years from August, 1909, and, in the event of the electrification not taking place, the present horse trams will remain. The directors were not able to say when the electrification will take place, but having regard to all the circumstances and to the state of the money market, they do not entertain much hope that, with the combined system, such as is now provided for, it will be possible for the work to be done at present; of course, if the trolley system alone had been or could be agreed upon, there does not seem to be any reason why electrification could not be carried out at once. There are two places in the South of England where combined systems are in operation, namely, Bournemouth and Hastings. At Bournemouth, the overhead or trolley system, and certain portions of conduit; at Hastings, the overhead and a certain small section of Dolter surface contact. The directors observed that the Bournemouth Council have recently decided to do away with the conduit and instal the whole on the overhead system; and at Hastings, also, your directors understand there is a movement to do away with the dual system and have only the overhead lines. The directors have protected the interests of the shareholders of this company, so far as the unpaid purchase money on the assignment of the Corporation is concerned which is secured by a charge on the undertaking. The profits of the undertaking are distributed by the Oxford Tramways Syndicate, Ltd., in accordance with the terms of settlement. Since the last report was issued, the directors declared a dividend of $2\frac{1}{2}$% in November, 1909, and now propose to recommend a distribution of the amount in hand by declaring a dividend of 2% free of income tax, which tax is paid by the Oxford Electric Tramways, Ltd., and to carry forward to the next account the sum of £93 19s. 2d. It will be remembered that the settlement on the transfer provided that £34,000 was to be paid in cash or debentures of the new company; as to £10,000 of this, the amount went in redemption of the then existing mortgage debentures, leaving a sum of £24,000 to be ultimately divided amongst the shareholders of this company, who, in addition, would be entitled to £4,800 in ordinary shares in the new company. The dividends paid since the transfer, namely, $2\frac{1}{2}$% in 1908, $2\frac{1}{2}$% in November, 1909, and the 2% about to be declared, are dividends on the old capital of £40,000, and not on the reduced capital of £24,000; so that, on the reduced capital, the shareholders, when receiving $2\frac{1}{2}$% per annum, are actually getting dividend at the rate of £4 3s. 4d. per cent. This is a less dividend than in former times, but it must be borne in mind that the undertaking has now to bear a rental of £800 to the City instead of £200 as in former times. Dividends are declared by the directors as and when the proportion of profits of the undertaking are paid over, and this depends on the declaration of a dividend by the syndicate.

COMPANIES REGISTERED.

ELECTRICAL UTILITIES CORPORATION.—Capital stock, $7,500,000, in $100 each (25,000 shares Preferred stock and 50,000 shares Common stock). Registered in Maine, U.S.A., on June 18, 1909. British address, 43, Threadneedle-street, E.C., where A. A. Kelsey is authorised to accept service.

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ERNST HILDEBRANDT, LTD.—£5,000, in £1 shares. Business: Manufacturers of ceramic articles and accessories used in the incandescent gas light and electrical industries; to acquire the undertaking in England of Vereinigte Magnesia Company and Ernst Hildebrandt Aktiengesellschaft, of Pankow-Berlin. Private company. Office, 44, Croft-street, Lower-road, Deptford, E.

S. BOTTONE AND SON, LTD.—£2,000, in £1 shares. Business: To take over that of an electrical and mechanical engineer and manufacturer carried on by A. E. R. Bottone at Wallington as S. Bottone and Son. Private company. Office, 93, Manor-road, Wallington, Surrey.

J. B. SAUNDERS AND CO., LTD.—£20,000, in £1 shares (6,000 "A" and 14,000 "B"). Business: That of electrical and mechanical engineers and contractors carried on by W. H. Radcliffe Saunders, J. H. P. Berthon and S. G. Leech, at 91, York-street, Westminster, and elsewhere, as J. B. Saunders and Co. Private company. Office, 91, York-street, Westminster.

INTERNATIONAL RAILOPHONES, LTD.—Capital, £10,000, in £1 shares. Objects: To carry on the business of electricians, telegraph and telephone makers and operators, etc., and to adopt agreements with Railophones, Limited, and H. von Kramer. Minimum cash subscription, 10 per cent. of the shares offered to the public. The first directors (to number not less than two nor more than five) are H. von Kramer and A. Stewart. Qualification, £50. Remuneration, 7½ per cent. of the net profits, divisible. Registered office, Prudential-buildings, Corporation-street, Birmingham.

ANGLO-SICILIAN CONSTRUCTION COMPANY.—£250,000 (£10). To acquire from the Government of Italy or other authority any contracts, decrees, enactments, concessions, or grants relating to the construction, restoration, reconstruction, or renewal of the cities of Messina and Palermo, Sicily, of tramways, railways, pavements, gardens, embankments, drainage, sewerage, and other works, etc. Caxton-house, Tothill-street, Westminster.

SANDWICH, DEAL AND WALMER ELECTRICITY SUPPLY COMPANY, LTD.—£4,000, in £1 shares. Business: That indicated by the title. Private company.

TRADE PUBLICATIONS.

We have received from the General Electric Company four catalogues of machinery, as follows:—(1) Continuous-current dynamos; (2) Alternating-current generators; (3) Continuous-current motors; (4) Alternating-current motors. These catalogues are printed in two colours, and are attractively got up in differently coloured covers.

Each list is prefaced by a lucid general and technical description, followed by a complete specification.

The tabulated price list portions are so arranged that a complete price of machines, together with accessories, can be found with remarkable ease.

The continuous-current dynamos are listed under two headings—High Speed and Low Speed—the former with two or three bearings and the slow speed with one bearing or two.

This excellent arrangement offers a large range of speeds for a given output. An extra price is quoted for inter-poles, and mention is made in the preface when these should be included in the price of the machine.

Separate tables are given for generators specially suitable for Osram lamp installations where accumulators are used for 25/37, 50/74 and 100/140 volts. Here also a large range of speed is given so that either belt-driven or direct-driven machines may be selected from these tables with equal facility.

A page is devoted to motor-driven series boosters, the prices of which include the complete machines, which we are told in a headline stand good when these machines are made suitable for cinematograph or searchlight work.

Two pages are devoted to balancers—one dealing with the rotary balancer, which is most often used in central stations; and the other with static balancers. Prices are given for the necessary transformers as well as the extra to be added on to standard generators for the fitting of slip-rings.

The alternating-current generator list commences with a general and technical description of Witton alternators, followed by two specifications—one of engine-driven alternators and the other of turbo-alternator (the latter being rather a novel feature in the catalogue world), which show the amount of thought and care that has been taken at the Witton works in the perfecting of all details—so essential in turbo-alternator design.

Of the company's catalogues, this one alone does not contain prices, for the reason that the requirements for alternators are so diverse that it is almost impossible for anybody to furnish a list of standard alternators which would come within a reasonable distance of completeness in this respect.

The speeds, weights, efficiencies and outputs are given of the standard machines for 25, 40 and 50 cycles, and the last three pages are devoted to illustrations of machines that have been manufactured in the company's works.

The continuous-current motor catalogue follows a similar plan to the continuous-current dynamo catalogue. Prices are given for constant speed machines in the semi-enclosed, enclosed ventilated and totally enclosed types for constant and crane rating.

A table of variable speed machines follows, with full particulars and prices, which will no doubt prove exceedingly useful to motor users throughout the world.

On every page, together with the price of the machine, prices are quoted for starters and slide rails, together with weights and dimensions of standard pulleys, and in a separate column the extra price for horizontally split frame. This information being gathered together on one page renders the catalogue a very quick and complete reference manual for estimators.

Following the spare parts and dimension drawings, a page is devoted to connections of standard machines of the different types.

This section is concluded with three pages giving the powers required to drive various machinery used in several industries.

We understand that this information has been compiled from reliable sources and that full confidence can be placed in the correctness of the horse-powers stated for each purpose. These three pages alone will no doubt prove immensely useful to users of electrical energy.

The alternating-current motor list is one of the most complete and comprehensive lists yet brought to our notice. The motors are listed for 25, 40, 50 and 60 cycles, two and three-phase, and 50 cycles single-phase; in each case the horse-power ranges from about ½ h.p. up to 100 h.p.

On each page prices are given for slip-ring and squirrel-cage motors, slide rails, open and closed starters and auto-transformers. Extras are quoted for enclosed and gas-tight slip rings and short-circuiting gear; columns of efficiencies, power factors, dimensions of standard pulleys and full load speeds complete the tables.

As in the other lists a complete price list of spare parts is given, and dimension drawings conclude the section.

A most useful feature in these lists is that the dimensions and weights throughout are given in English and metric units.

PERSONAL.

Mr. W. M. Valon, of South Shields, has been appointed engineer and manager in full charge of the gasworks, and to supervise the electricity department at Stafford. The salary is £350, rising by £25 yearly to £500.

Mr. H. N. Sporborg, Chief Engineer, and Mr. W. C. Lusk, manager of export department of the British Thomson-Houston Company, Ltd., have been appointed members of the board of directors.

Mr. Ira Lockwood, who was articled as a pupil to Mr. A. B. Mountain, the Borough Electrical Engineer, and was afterwards for four years assistant engineer in the Electricity Department of the Huddersfield Corporation, has been appointed Mains Superintendent to the Kent Electric Power Company, which company has power to supply electricity over the whole county of Kent. Before leaving the staff and employees of the Electricity Department presented Mr. Lockwood with a handsome travelling case upon the occasion of his leaving to take up this important appointment.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

APPOINTMENTS.

COUNTY BOROUGH OF STOKE-ON-TRENT.

ELECTRICAL ENGINEER'S DEPARTMENT.

The Town Council invite Applications from thoroughly qualified Persons, of not less than 20 years of age, for the following Positions in the above department:—

(a) Meter Reader, Tester, and Fixer, at 26s. per week.

(b) Arc Lamp Trimmer and Repairer, at 30s. per week.

(c) Mains Jointer, Arc Lamp Trimmer, and Meter Fixer, at 9d. per hour.

Applicants for positions (a) and (c) must have had practical experience with fixing and testing direct-current meters, and for positions (b) and (c) practical experience of trimming and repairing arc lamps.

Applications, on forms which may be obtained from the Electrical Engineer, must be forwarded to me, endorsed "Meter Reader," "Arc Lamp Trimmer" or "Mains Jointer," as the case may be, on or before Saturday, December 3, 1910.

E. B. SHARPLEY,
Town Clerk.

Town Hall, Stoke-on-Trent.

CITY OF BIRMINGHAM.

ELECTRIC SUPPLY DEPARTMENT.

Applications are invited for the post of JUNIOR ASSISTANT ENGINEER in the Business Development Department.

Applicants must have good technical knowledge of the applications of Electricity for Lighting purposes.

Preference will be given to applicants who have had previous experience in the designing and carrying out of lighting installations, and who have held similar posts under a supply authority.

Salary will commence at £100 per annum rising to £150.

Applications giving full particulars of age, previous experience since leaving school, and date when duties can be commenced, accompanied by copies of not more than three testimonials, must be sent to the undersigned not later than FRIDAY, DECEMBER 9th, endorsed "Applications for Junior Assistant."

R. A. CHATTOCK, M.I.E.E.,
City Electrical Engineer and Manager.

14, Dale End, Birmingham.
November, 1910.

COUNTY OF LONDON.

The London County Council invites applications for the appointment as demonstrator in Electro Technology at the L.C.C. Paddington Technical Institute, Saltram Crescent, W., at a salary of £100 a year. Candidates should have a good theoretical and practical knowledge of electricity.

Applications should be made on the official Form T. 17, to be obtained, together with particulars of the appointment, from the Education Officer, London County Council Education Offices, Victoria Embankment, W.C., to whom they must be returned not later than 11 a.m. on December 10th, 1910, accompanied by copies of three testimonials of recent date. All communications on the subject must be endorsed "T. 1" and a stamped addressed foolscap envelope must be enclosed. Canvassing, either directly or indirectly, will be held to be a disqualification for employment.

G. L. GOMME,
Clerk of the London County Council.

Education Offices,
Victoria Embankment, W.C.
November 29th, 1910.

CONTRACTS OPEN.

HOME.

BARKING TOWN.—The Urban Council invite tenders for the supply and erection of (A) 400 kw. Diesel engine and dynamo; (B) 250 kw. motor generator; (C) traction battery and reversible booster; (D) main switchboard and connections; (E) overhead travelling crane. Particulars from the Municipal Electrical Engineer, Barking, Essex. December 20.

BIRMINGHAM.—The Corporation invite tenders for the supply and erection of 60 electric tramway cars. For particulars, apply to General Manager, Tramways Department. December 12.

LONDON. The London County Council invite tenders for the overhead electrical equipment on the trolley system required in connection with the construction of the new tramways, approximately one mile in length, between Putney-bridge and Wandsworth High-street. Specifications, bills of quantities, form of tender, etc., from the Department of the Clerk of the Council, County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of £2. December 6.

RAWTENSTALL.—The Corporation invite tenders for the extension and alterations to the municipal tramway depot. Particulars from the Borough Surveyor. December 13.

ROTHERHAM.—The Corporation invite tenders for (1) high tension feeder, (2) rotary convertors, transformers and switchgear. Particulars (42s.) from the Borough Electrical Engineer. December 13.

OVERSEAS.

BRISBANE.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up to noon on January 4, 1911, for the supply of (1) poles and ironwork (Schedule No. 141), and (2) 17 magneto switchboards (Schedule No. 142). A deposit will be required with each tender. Local representation is necessary. January 4.

CONSTANTINOPLE (Extension of Time).—The Municipality invite tenders for the construction and working of electric tramways in Constantinople and suburbs. Extension from November 10 to December 20.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley-system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham House, Old Broad-street, E.C., and Central House, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a *bona-fide* tender.

JERUSALEM.—The Municipality invite tenders for (2) electric tramways and electric lighting installations in the town; (4) telephone installation at Jerusalem, Jaffa and Bethlehem. Tenders in respect of each of the above schemes will be received by the municipal authorities up to December 31. Local representation is desirable.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 5¼ miles of lead-covered, paper-insulated telephone cable (Schedule No. 407). A deposit will be required with each tender. Local representation is necessary.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 200 contacts, plug seat, and 2,350 condensers (Schedule No. 402). A deposit will be required with each tender. Local representation is necessary. January 10.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

TAIHAPE, NEW ZEALAND.—Tenders are invited by the Taihape Borough Council for the supply and erection of a hydro-electric lighting and pumping plant. Tenders, marked "Tender for Electric Plant," will be received by the Town Clerk, Taihape, N.Z., up to 5 p.m. on January 11, 1911. A deposit of £130 must accompany each tender.

TENDERS ACCEPTED.

BELFAST.—The Corporation have accepted the tender of the British Insulated and Helsby Cable Company, Ltd., for the supply of mains.

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HULL.—The Tramways Committee have accepted the following tenders: Building extensions of car sheds, Messrs. C. Greenwood, Hull, £3,676; construction of steel roof, Messrs. J. Mundy, Glasgow, £754.

NORWICH.—The Corporation have accepted the tender of the Chair Belt Engineering Company, of Derby, for the supply of a coal elevator at £88.

CONTRACTS WORTH WATCHING:—

Below is a list of contracts recently given or tenders invited. Although we have no means of ascertaining whether in all these cases electricity is to be used, it is presumed from the nature of the cases that this will be so.

ASHBURTON: H. V. Foot, Biala, Ashburton, Devon. Rebuilding house and shop.

HOLYHEAD: J. Owen, architect, Exchange-chambers. Alterations and additions to Victoria Hall, Market-street.

NEWCASTLE-ON-TYNE: Secretary, Education Offices. Alterations to Bentinck Council School.

SWANSEA: J. Thomas, Town Clerk. Erection of 103 cottages.

TORQUAY: There is a proposal to erect Municipal Medical Baths.

TRURO: A. J. Cornelius, architect, Truro. Erection of mill at Malpas-road.

WELSHPOOL: Shalley & Ridge, architects, Oswestry. Additions to County Schools.

NOTES.

New Electrical Firm.

Mr. Harold A. Neale and Mr. George J. Freund having severed their connection with Messrs. Crompton and Company, have now set up in business as electrical engineers and contractors at Chelmsford and at 31, Budge Row, Cannon-street, E.C., under the style of Neale & Freund, Ltd.

Asbestos Resistance Nets.

Mr. H. H. Cressall, of Summer-place, Birmingham, has been appointed sole agent in Great Britain for the Schniewindt Asbestos Woven Resistance Nets for starting and controlling apparatus, cinematograph lamps, electrical heating and cooking appliances, etc.

"Tantalum" Illumination.

The photograph which we reproduce here shows the illumination of a bandstand at one of the large London entertainment palaces. It is a very striking example of the efficient illumination which can be obtained from "Tantalum" metal filament lamps situated in the open, where they are subjected to the inclemency of the weather, which most people will agree has not been at all favourable during the present year. It should be still more interesting

as at the present time of year shop-keepers and tradesmen are arranging for effective displays for Christmas, and certainly no display is complete without illumination effect. It is obvious, however, that a lamp of the most durable type is required for exteriors, and "Tantalum" and "Onewatt" lamps, manufactured by Messrs. Siemens Brothers Dynamo Works, Ltd., have filaments of drawn wire, which accounts for a degree of strength not obtainable in other lamps at present on the market. Nearly all contractors supply these lamps, and we can safely recommend them in connection with Christmas illuminations. Many contractors are doing a remarkably good business in these lamps, and are feeling the benefit of the very extensive advertising campaign, which has been largely to the consumer as well as to the trade. The annual sales of these types of lamps are steadily increasing, and the demand threatens to be heavier than ever during the next few weeks. We may also say that in cases where it is still desirable to use carbon filament lamps for temporary illumination, it would be advisable for contractors to communicate with Messrs. Siemens Brothers Dynamo Works, Ltd., Tyssen-street, Dalston, London, N.E., who have recently increased their discounts.

A Foretaste of Christmas.

The keynote of the adult Briton's pious celebration of Christmas seems to be the desire which we all have (hidden away somewhere within us) to return to the age of innocence. "The boy is father of the man," and the father never quite loses, or loses involuntarily, his memory of what it is to be a boy. Certainly there is, in every man, a large amount of latent boyishness. The Christmas festival seems to call it into active life, and sometimes with strange results. Imagine the grave Judge of the High Court capering with the future Bar round a brilliantly-lighted Christmas-tree; or on his hands and knees playing bear. Picture the harassed station engineer (always supposing he has been able to leave the scene of "shorts" and "burn-outs"), his brow strangely devoid of wrinkles, teaching the young idea to "burn-out" the "cable" in one of Tom Smith's specialties. Such happy scenes ought not to be marred by un-

toward mishaps. Yet accidents happen—especially with the Christmas-tree. The candles have a nasty habit of setting other things alight, the grease has a particular predilection for the nicest frocks, and it is unnecessary to mention that the smell of the burning Christmas-tree, set smouldering by the last flicker of a burn-out candle, is exceedingly unpleasant. These little mishaps (which sometimes develop into big accidents) led some bright spirit to ruminate as to whether electricity could not be pressed into the service of Father Christmas. The result of his ruminations was the Westinghouse candle lamps for Christmas-tree decoration. These lamps give a much better effect than the old-fashioned candles, are infinitely safe, and have the advantages of being without smell and mess. They will, of course, burn as long as required—a vast improvement

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over the old candles, which require renewing every hour or so if continuous illumination is required.

The lamps are sold in sets, each set consisting of 20 11-volt flame-shaped incandescent lamps, with holders and clips for attaching the lamps to the branches of the Christmas tree. Each holder is provided with flexible connectors enabling the lamps to be easily connected in series to suit the voltage of the supply. A length of flexible insulated wire and a plug adapter for fitting to a lamp holder are also provided. The price per set is extremely moderate, and dealers are recommended to write for terms to the Supply Department of the British Westinghouse Electric and Manufacturing Company, Ltd., 3, West-street, Charing-cross-road, London, W.C.

"Stannos" Wires and "Zed" Cartridge Fuses.

Messrs. J. H. Harpin, electrical contractors, of Birmingham, are now carrying out an installation of 450 lights at the Hawkesyard Priory, Rugeley, with "Stannos" wires, using the sheathing as the return conductor and "Zed" fuses are used throughout. The power is supplied by a Siemens generator driven from an Austin petrol engine. The switchboard is being made by Siemens Brothers Dynamo Works, Ltd. A 60-cell battery by Pritchetts & Gold is being installed. The generating plant is provided with Walker Horrocks & Company's system of automatic control, whereby the generating set starts itself as soon as the battery voltage falls below a certain value. Siemens cables are used throughout.

Messrs. S. Gillett are carrying out the wiring with "Stannos" at the church at Whitley Bay, Northumberland, and that firm is also carrying out for Siemens Brothers the complete electric installation, including 10 h.p. generating plant, with battery and switchboard, of a private house at Haydon Bridge, Northumberland.

Osram Publicity.

What may be called the latest Osram effort, takes the form of a double crown poster, reproducing the well-known comet design used on the General Electric Company's larger posters already issued and largely used throughout their present advertising scheme. It is an excellent production, and we may mention the fact that the firm are willing to supply copies to the trade free of cost, for local display, upon receiving intimation from any dealer that he is able to make use of them.

Fire-Resisting Flexibles.

Messrs. Siemens Brothers & Company, Ltd., have brought out a new and complete catalogue, No. 532, "Vulcanised India-Rubber Wires and Cables," which supersedes the provisional catalogue of the same title, published at the commencement of October, and all previous publications on the same subject.

The catalogue contains, besides the usual Association and Non-Association wires and cables of their make, a special section dealing with bell wires, and flexible wires for electric light, etc. Amongst the latter, we would draw our readers' special attention to the new "Besto" fire-resisting flexible twin wires. These have been put on the market owing to the demand for special twin flexibles for shop-window lighting. Siemens' "Besto" flexibles are less clumsy than the ordinary asbestos covered wires, because, whilst the latter are covered with braided asbestos, their new wires have the asbestos spun on them direct by a special process, for which they hold the patents. The samples of these wires which we have seen are excellent for all kinds of permanent and temporary lighting.

The catalogue contains, in addition, some practical tables for the use of those engaged in wiring work.

Battery Lamps for Decorations.

We would call our readers' special attention to the "Robertson" battery lamps, varnished in different colours and brought out by the General Electric Company, Ltd., for Christmas, New Year, and other festive decorations. The lamps are carefully selected so as to fit them for wiring in series on old voltages. The prices are quite moderate. An attractive item at this moment are the Christmas tree decoration strips wired complete with 24 G. silk covered wire.

APPOINTMENTS VACANT.

The County Borough of Stoke-on-Trent have the following vacancies on their electrical staff: Meter reader, tester and fixer, at 26s. per week arc lamp trimmer and repairer; 30s. per week; and mains jointer, arc lamp trimmer and meter fixer, at 9d. per hour.

The London County Council invite applications for a demonstrator in electro technology at the L.C.C. Paddington Technical Institute. Salary £100.

The City of Birmingham requires a junior assistant engineer in the electricity business development department, and offer a salary of £100 a year.

ELECTRICAL ENGINEERS (TERRITORIALS) London Division.—Orders for week ending December 10, 1910. Officer Commanding, Col. H. M. Leaf. Technical Drill 7 to 10 p.m.: Monday, December 5, "A" Coy.; Tuesday, December 6, "B" Coy.; Thursday, December 8, "C" Coy.; Friday, December 9, "D" Coy.; Saturday, December 10, week-end run at Sheerness, parade at Victoria Station S.E. & C. Railway, 1.10 p.m. and 4 p.m. (see Nov. Rgl. Orders).—(Sd.) P. H. Campbell, Capt. R.E., Adjutant.

ERRATA.—We regret that in our report of the discussion following Mr. C. F. Smith's paper on "The Polyphase Induction Motor" we attributed Mr. Warrall's remarks to Mr. T. F. Wall.

PATENTS.

Cable Connections for Electric Burglar Alarms.

24076.—1909. A. BLOCH, Paris. This composite flexible cable for burglar alarms comprises an insulated metal core surrounded by concentric metal conductors each insulated from the others. When the cable is cut, a short circuit is caused and an alarm is given.

Electric Pocket Igniter.

24130.—1909. F. DEIMEL, Berlin. One casing receives the wick and the igniting device, and a second casing at the side of the first contains the source of current and the switch. The igniter proper and the battery are electrically connected with their casings by inserting them in position.

SECOND EDITION, REVISED AND EXTENDED.

The Principles of Electric Wave Telegraphy and Telephony,

By J. A. FLEMING, M.A., D.Sc., F.R.S.,

Pender Professor of Electrical Engineering in the University of London, &c.

With 7 Plates and numerous other illustrations. 8vo. 28/- NET. (Inland Postage 6d.)

LONGMANS, GREEN & CO., 39, Paternoster Row, London, E.C.

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Direct Current Electric Motors.

24023.—1909. E. K. Scott, Bromley. This small current motor has permanent laminated magnets, an armature wound with iron wire and a cheap non-magnetic metal commutator. The motor is cheaply and simply constructed, and is designed for use where 3 h.p. or less is required.

Dynamo Electric Machines.

24126.—1909. General Electric Company, Schenectady, U.S.A. This double alternating current generator has a single armature and a single field magnet. The armature has coils and connections forming electrically two windings of different pole numbers. The field magnet has coils and connections for producing two component magneto forces in the magnet simultaneously which correspond in pole numbers to the two pole numbers of the armature. By variation of the relative strength of the field magneto motive forces the voltage of both currents delivered by the machine as a double current generator may be varied independently.

Regulating the Voltage of Alternating Current Machines.

24127.—1909. C. A. Parsons & A. H. Law, Newcastle-on-Tyne. The object is to supply means whereby compounding devices may be made to automatically supply the right amount of compounding for loads having different power factors. For this purpose the current in the winding of the leakage path is caused to be greater when the load is inductive than when it is non-inductive by means of a synchronously rotating inductor adapted to vary the reluctance of a magnetic circuit.

Dynamo Electric Machines.

24434.—1909. F. W. Carter, Rugby. The object is to provide an improved means for collecting current in dynamo electric machines of the commutating type. For this purpose an additional winding is provided, the active conductors of which are close to the armature conductors undergoing commutation. The winding carries a current running in the same general direction in the active conductors as in the armature conductors after commutation. The conductors are so distributed and arranged that they cause the collection of current to be effected with sensibly uniform current density.

Electric Welding.

24958.—1909. S. Jevons, Hampton-in-Arden. A sheet of perforated metal, having a melting temperature corresponding with the parts to be joined is placed between the surfaces. An electric current is then passed through until the metal of the three pieces at the contacting points is melted. Pressure is applied to force the parts together. The perforated sheet makes the weld to be effected over a large surface with a minimum of electrical energy.

Electrical Propulsion of Ships.

25734.—1909. Siemens Bros. Dynamo Works, Ltd., Dr. M. Kloss, Westminster. This is a method for driving a ship having four propellers by means of electric asynchronous induction motors and generators. Two of the motors are driven electrically at normal speed by generators, the frequency of which is higher than the frequency of the generators which drive the remaining motors at normal speed. In order to obtain successive reductions in speed means are provided whereby the normal electrical frequencies of one or more of each set of generators having different normal frequencies can be halved at constant speed and the electrical connections between generators and motors can be interchanged.

Transmission of Messages by Wireless Telegraphy.

27395.—1909. British Radio Telegraph & Telephone Company, & J. G. Balsillie, London. This is a telegraph system in which the primary energy is derived from an alternating current generator. A discharge apparatus is provided furnished with forwardly curved arms mounted to revolve between fixed electrodes. When the condenser discharge is broken up a musical note is produced, having a frequency independent of that of the alternating current.

Preventing Corrosion of Electrical Terminals.

29773.—1909. H. A. W. Middleditch, Arundel. A washer is provided comprising a fibre body with a central recess to receive lubricant which is retained in place by means of a cap.

Connection of Single-Phase Motors to Polyphase Systems.

645.—1910. Aktiengesellschaft Brown Boverie & Company, Baden. In this arrangement for working two coupled single-phase motors connected in Scott connection to a rotary system, the Scott connection is effected by means of the motor windings.

High Tension Magneto Machines for Internal Combustion Motors.

2883.—1910. Etablissements de Dion-Bouton, Puteaux. In this rotating coil high tension magneto machine of the geared distributor type the gear is insulated from earth and effects electrical connection between the armature and distributing device.

Electric Cables.

1194.—1910. Siemens Bros. & Company, & W. Diselhurst, Westminster, S.W. The cable conductors are covered directly with hygroscopic material surrounded by non-hygroscopic material and provided with a metal screen, such as light foil, to prevent moisture effects arising from contact of the two kinds of insulation.

Magnetic Speedometer.

1915.—1910. J. K. Stewart, Chicago. This speedometer comprises a magnet, an armature and a non-magnetic disc placed between the armature and the magnet poles, mounted for oscillation about an axis and provided with means for biasing it to a position of rest. The armature is an annulus which encompasses the magnet and both are mounted for rotation together about the axis of oscillation of the disc.

Electric Cables.

3818.—1910. Siemens Bros. & Company, & W. Dieselhurst, Westminster. A layer of metal foil is placed between two or more layers of non-hygroscopic insulators to prevent mechanical contact between such layers.

Operating Track Points on Electric Tramways.

5823.—1910. J. J. Fanning & F. F. Nellis, Cantley, Canada. The contact members of the device are operated indirectly through a lever which carries contact fingers connected in the electric circuit. The lever is disposed normally so that the fingers are not in contact with the contact member whereby the latter is normally not in the electric circuit. This reduces the risk of shock to attendants through the passage of current through the mechanism.

Magneto Electric Ignition Machine.

6653.—1910. R. Bosch, Stuttgart. In this magnet frame the correct position of the steel bars constituting the field magnets relative to the armature casing is secured by providing the bars and the casing with fitting surfaces which abut one against the other. The fitting surfaces are so placed that the magnets can be applied to the casing only in one direction. Ears are provided on the casing and these are turned over to embrace the magnets.

Dynamo Electric Machines.

10208.—1910. A. Meynier, Lille. The dynamo is adapted to be coupled direct to high speed motors for the production of currents of very great intensity, and for other uses. The armature bars are connected at one end to a slip ring upon which brushes rest forming one terminal of the dynamo. The other end of the bars are connected to the end segments of an ordinary commutator in which rest as many sets of brushes as there are poles arranged.

Terminals for Electric Cables.

11600.—1910. R. Bosch, Stuttgart. The sheath of conducting material which forms the cable terminal is provided with a conical end and is inserted for a portion of its length in the insulation of the cable.

Windings of Dynamo Electric Machines.

14862.—1910. Allgemeine Elektricitats Gesellschaft, Berlin. In this machine the windings of which are secured to the rotating member, the coil holders are constructed in the form of laminae which are inserted in the groove with their surfaces parallel to the direction of the groove and then turned round so that their surfaces lie across the direction of the groove.

Commutators for Dynamo Electric Machines.

19539.—1910. Siemens Schuckertwerke, G.m.b.H., Berlin. In this commutator, which has outer shrink rings, inner conical supporting rings and a spring tensioning arrangement, the conical supporting ring is displaced from its usual position at one extremity of the commutator towards the other extremity. The whole or part of the tensioning arrangement is accommodated in a space between the segments and the shafts.

Electro Motor Sound Producer.

16895.—1909. S. Evershed, W. D. Kilroy, Chiswick. This vibratory electric motor sound emitter is operated by steady and changing magnetic fluxes, and is arranged to have no wasteful interference. For this purpose the operating coils are adapted to carry direct and alternating currents, and are so arranged as to have no wasteful mutual induction.

Electric Lamp Holder.

23634.—1909. H. E. Steward, Hammersmith. The holder comprises a tube screwed to collars on the lamp frame and reflector. The tube has a screw collar to which a holder is fitted for focussing the lamp with regard to a lens.

Electric Drive for Railway Vehicles.

24843.—1909. Aktiengesellschaft Brown Boverie et Cie., Baden. This is an improved drive in which either the motor or the wheel axle comprise a hollow shaft. The two parts are connected through a universal or jointed coupling.

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PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

Westinghouse Type "O" Ampere-Hour Meters.

The British Westinghouse Electric and Manufacturing Company, Ltd., Manchester, have designed and placed upon the market a large and comprehensive range of electrical instruments both for switchboard and portable use.

A recent development in connection with the metering of direct-current in lighting and power installations is shown in the accompanying illustrations, which depict the new Westinghouse Type "O" Ampere-hour meter.

This meter, entirely British made throughout, is of single design and well calculated to satisfy in every way the requirements of supply authorities to whom the accurate measurement of the current taken by small consumers is of ever-increasing importance. It is of the motor-driven type, a low resistance shunt, carrying the main current. To enable a suitable range of speed adjustment an adjustable resistance is provided. The case

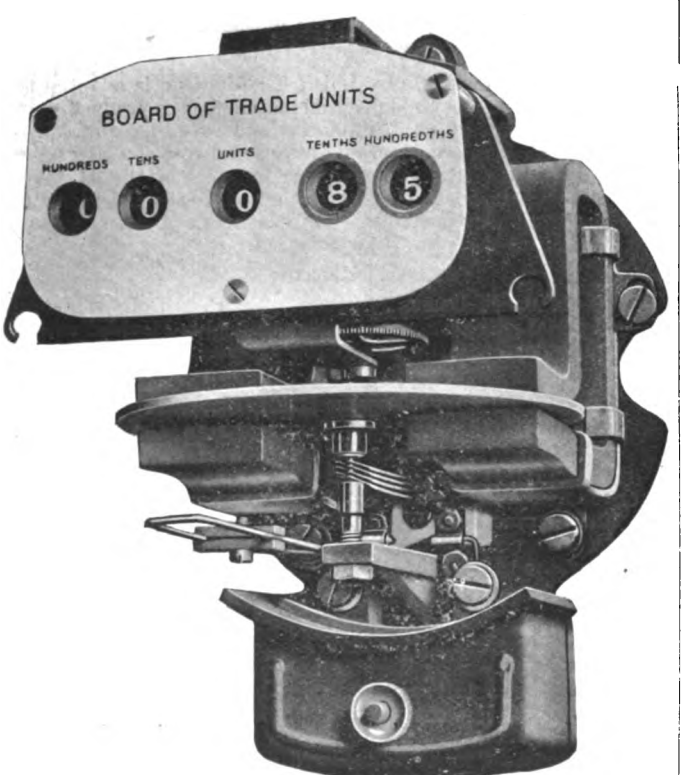
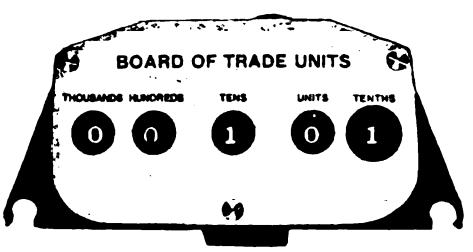


FIG. 1.—COMPLETE METER.

as well as the cover of the type "O" meter are of iron highly finished in either black or French grey stove enamel; clock-face or cyclometer dials are supplied as desired, which can be arranged to read either ampere hours or B.O.T. units.

The cyclometer dial designed by the British Westinghouse Company is of special construction, being provided with a novel springing device which prevents the halving of figures when turning over, a frequent error in reading cyclometer dials of the ordinary type. Its design is such that both the turning moment and resulting friction are reduced to a minimum. The Westinghouse type "O" ampere hour meter is extremely small and light, and an efficient washer renders it completely proof against damps, dust or dirt. All these meters can be supplied for use on two-wire circuits up to 500 volts, and for capacities from one to 200 amperes inclusive. The degree of accuracy obtained is guaranteed within — ½ per cent. from 25 per cent. overload to one-twentieth of full load.



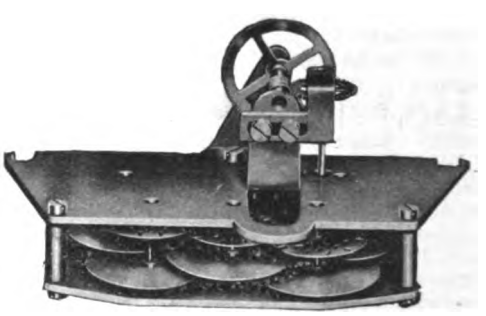
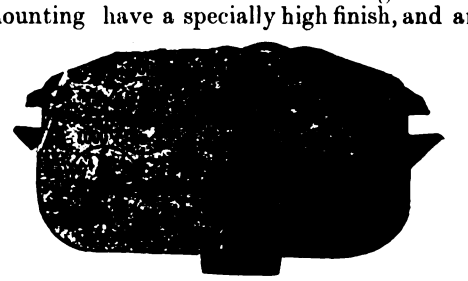


FIG. 2.—CYCLOMETER.

In addition to the standard hoist service type described above, type "O" meters may be supplied for use as either battery or switchboard meters. Those designed for switchboard mounting have a specially high finish, and are fitted



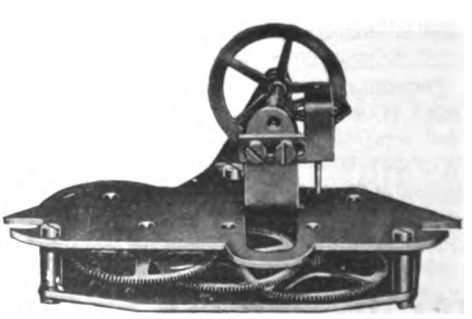


FIG. 3.—CLOCKFACE.

with a glass cover and back connections. For three-wire circuits two meters are required.

Further complete details relating to these meters will be found in the catalogue No. 354/1 just issued by the firm.

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THE
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NOTES.

Future of the Telephone.

One would scarcely expect to find the Associated Chambers of Commerce advocating municipalisation of any service having a commercial character. Yet the hard logic of facts has compelled the Telephone Committee of that body to recommend that when the telephone business passes into the hands of the Government local administration should be entrusted to municipalities. The reasons advanced are :—" 1, The excessive charges to subscribers if the Post Office insists on the measured rate ; 2, That under municipal management there would be greater efficiency and less expense, the Committee being satisfied that under Government control the cost of administration would increase, and a less effective service would exist ; 3, The accounts of the Hull Corporation telephone system prove that the municipalities can provide a cheap and efficient service, which can be made to yield a substantial profit, even in face of the competition of the National Telephone Company and the Post Office." We note that the Leeds Chamber of Commerce, after a little criticism, adopted the recommendation, as others have done.

The Institution of Signal Engineers.

In a recent issue we announced the coming into being of the Institution of Signal Engineers. It was inaugurated last month and already bids fair to do useful work. Mr. A. T. Blackall in his Presidential Address sketched out a tolerably ambitious programme. The scope for its activities is far greater than would appear at first sight. Mr. Blackall said :—" In speaking just now of the scope of the Institution, I mentioned that those responsible for its inception had in mind a very comprehensive interpretation of the generic expression *signalling*. Now it is, I think, quite time that we should discard the somewhat restricted application of the expression prevalent in the past, and make up our minds as to what we mean when we speak of *signalling*, and what kind of work it is that a signal engineer should be qualified to perform. If, by the expression *signalling*, we mean the whole of the methods and means by which the movement of traffic is controlled, and this, as it seems to me, forms a very fair definition, we shall find that we have travelled a good way beyond the earlier conception, and we shall find also that the definition involves the inclusion of a good many considerations which are, perhaps, not at first apparent. The root idea of the expression is the controlling of the movement of traffic, that is to say, the preventing of moving vehicles from colliding with one another, and, in the case of vehicles moving on rails, the preparation and securing of the appropriate route ; or, to put it more concisely, if less exactly, signalling provides for the safety of moving vehicles."

Electric Lighting and Coronation Decorations.

In view of the Coronation of King George next June, the London County Council have been considering the question of the precautions that should be adopted for minimising the possible risk of fire from the arrangements that may be made for the street illuminations. The Council are quite right in thinking that owing to the rapid development and extension of electric lighting during the past ten years, the use of electricity for decorative illumination will be great. Although the Council have no power to make any regulations in the matter, having been approached from various quarters, have had the following suggested list of precautions drawn up by the Chief Officer of the London Fire Brigade :—

(1) All installations should be inspected, tested and approved by the local supply authority before connection is made, and any installation that has not a satisfactory insulation between poles, and between either pole and earth, should not be connected.
(2) All circuits and sub-circuits should be provided with properly proportioned fuses to each pole : and sub-circuits should be limited to a maximum of (say) two kilowatts each, and should be arranged with due regard to current density in the conductors.
(3) No bare conductors should be used, and all conductors within reach of the public should be specially protected by suitable conduits : and all metal conduits or coverings should be efficiently " earthed."
(4) All switches, fuses, terminals and connectors should be protected from effects of weather and from possibility of mechanical injury.
(5) Festoons, garlands, etc., containing lamps should be provided with means of support independent of, and insulated from, the conductors, and should be secured in such a manner as to minimise risk of injury from wind.
(6) All shades and decorations of combustible materials in proximity to lamps should be rendered non-inflammable by a process which will withstand the action of rain for several days and no shades or decorations of celluloid or similar substance should be used.
(7) The installations should be connected, where practicable, at the main intake, or at the main distribution boards, so as to avoid the possible overloading of the house wiring.

We understand that a copy of this list is being forwarded to each of the local authorities and companies supplying electricity in London, at the same time disclaiming any responsibility in the matter since, apart from the question of the Council having no direct jurisdiction, detailed inspections by the Council would be necessary, and this would be impracticable, having regard to the fact that the installations would be fitted only a few days before the date of use : but a system of inspection such as could be organised by each supply authority for its own district and in its own interest would be of great advantage in reducing the fire risks, which, in crowded resorts and thoroughfares, might otherwise be serious.

An International Auxiliary.

In the course of a recent article in THE ELECTRICAL ENGINEER on the subject of an International Auxiliary Language for Scientists, some considerations were put forward in support of the claims of Ido to perform this important function. It has been claimed for Ido—an indubitably sincere and earnest effort of reputable cosmopolitan scientists and scholars—that it is not a rival of Esperanto, but an evolution from that now all but universal system, and that so far as the technicalities of science are concerned, its aim is simply to take up the subject from the point where Dr. Zamenhof left it. But it would appear from the proceedings of recent gatherings of Esperantists in the United States and on the Continent that those weaknesses in Esperanto which gave rise ten years ago to the first Ido conference, have in the meantime been fully realised and adequately met. One of the points brought forward by the Idoists when the " Delégation pour l'adoption d'une langue auxiliare internationale " came into existence in 1900, was that if the Esperantists

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could do no better than translate the sentence " a rotary transformer might be called a motor generator, but the latter name is usually applied to machines with independent armatures " by " turnighan alispecigilon oni povas nomi motorproduktanto "—(literally " a self-turning otherwise-making instrument can be called a motor-producer ") their international auxiliary was of no use to electricians. Since those days, however, Esperanto has made long strides; and we are assured by one of its most prominent advocates in London that it is at the present moment fully equal to meeting the most exigent demands, not only of the electrician, but of practically every other technicologist.

Arc Lighting at Bromley, Kent.

An interesting experiment in street lighting by arc lamps is being made at Bromley, Kent. The gas and electric supply are both in the hands of companies, and the Municipality has a contract for the lighting of the streets with gas. The shopkeepers in the High-street are not satisfied with the present gas lighting, and as they found that they could not obtain any improvement they simply took the matter into their own hands and arranged a contract with the electric light company. A committee of tradesmen has been formed to arrange prices and allocate the proportion of the expense of the initial and running cost amongst the various shopkeepers who are benefited.

Permission to fix rosettes on the various buildings was readily given by the property owners, and the whole matter is an excellent example of how a number of tradespeople can act collectively. In these competitive days it is not often that one hears of such action, and we commend the action to other towns where inefficient gas lighting " holds the fort " through vested or other interests.

COMMERCIAL TRAINING OF THE ENGINEER.

By E. Kilburn Scott, M.I.E.E., A.M.Inst.C.E.

In his inaugural address at Birmingham, before the Institute of Electrical Engineers, Mr. M. J. Railing said :—

The young electrical engineer abroad, is encouraged to study in addition to his own science, the technology of allied trades, and to train himself as well in languages, in commercial law, in natural economy, and in commercial routine generally. I plead that such an excellent course may some day be adopted in this country as well. I further plead that the commercial side of engineering should be considered in our present system of apprenticeship.

For many years I have been interested in the question of giving young engineers some commercial training; in fact, I first recognised the importance of it a dozen years ago, when I had some of the pupils at Johnson and Phillips through the estimating department, of which I then had charge.

Most of them were like fish out of water when they first came, and some never did any good, for, although technically sound, they had not the methodical office habits, and natural grasp of financial detail to make their stay in the estimating department a profitable one.

Other men dropped naturally into the work, and learnt to draft specifications, dictate technical business letters, or make up detailed estimates for such straightforward matters as dynamos, lighting plants, etc. Some of them are to-day successful sales engineers or in charge of the estimating departments of various firms.

Now clearly, it is not possible or advisable for firms to allow a number of young men to pass through their commercial departments. For one thing, there is usually not office room, and for another it is not wise for a firm's cost sheets and other financial data to become too widely known. Therefore, if young engineers are to be able to obtain some idea of commercial methods, the details of estimating, etc., these subjects will have to be systematically taught in technical colleges by other outside means.

Four years ago, a course on Quantities and Estimates for mechanical engineers was started at the Northampton Institute, Clerkenwell, and Dr. Mullineux Walmsley and Mr. Larard have since been successful in persuading the City and Guilds to establish an examination in the subject.

On returning from Australia two years ago, Dr. Walmsley asked me to draw up the syllabus for a course on Quantities and Estimates for electrical engineers, so this is the second Session I have been lecturing on the subject. I think it may be said to be successful, from the fact that the class is about 25 strong, and is entirely composed of young men who have recently started in business. They are exceptionally keen.

The following are the main heads of the syllabus :—

PRIVATE LIGHTING.

Systems of wiring—casing, tubing, running wires on insulators, Stannos and flexible wiring. Notation of points, setting out lights on architects' plans. Arranging convenient positions for fuseboards, switchboards, meters. Special requirements for lighting—shop windows, churches, large halls. Sample estimates for private lighting installations. Prices of materials—cables, casing, tubing, stannos wiring, switches, fuseboards, fittings, lamps. Cost of labour and superintendence. Price per point. Effect of introduction of metal filament lamp.

PUBLIC LIGHTING.

Arcs for street lighting. Distances apart of arc lamps and incandescent lamps. Illumination curves. Costs of poles, posts, and brackets. Sample estimate for street lighting. Useful data from various installations. Comparison with cost of gas.

ESTIMATING OFFICE.

Office routine. Filling price-lists, cost sheets, correspondence, the effective following up of tenders. Co-ordination with drawing office and accountants' department. Sales engineers. Examination of consultants' specifications, safeguarding against penalties. Method of calling for tenders and of adjudicating on tenders received. Preparation of catalogues. Importance of considering running cost as well as prime cost when purchasing prime movers. Half pro rata rule for calculating new machine from prices of smaller and larger machines. Price curves and formulæ to suit them. Allowance for variation in cost of material. Establishment charges and shop charges. Carriage of goods. Shipping and agencies.

WORKS.

Premium systems of paying wages. Allocation of costs of rent, rates, taxes, insurance, heating, lighting, and building repairs. Depreciation of buildings and machine tools; Antiquation of drawings, patterns, tools, etc. Setting out and analysis of factory costs. Questions of supply of skilled and unskilled workers. Effect of automatic machines on costs.

MOTOR DRIVING.

Consideration of the rules for use of electric power in factories. Horse-power required for various types of machines. Method of finding horse-power and the most suitable rating. Size and cost of motor. Relative costs and weights of semi-enclosed, pipe-ventilated, and entirely enclosed motors. Various methods of driving. Starters and regulators. Quantities and costs for a typical motor installation with direct-current, and with 3-phase motors.

TRACTION.

Costs of typical tramcar equipments, motors, controllers, resistances, cabling, switches, etc. Cost per mile of track and overhead equipment. Financial considerations of urban, suburban, and main line railway electrification.

TRANSMISSION.

Relative amount of copper used for various methods of transmission. Cost of copper and of aluminium for overhead wires and cables. Relation of cost of metal to cost of insulation. Cost per mile for transmission lines with wooden poles and with steel poles and steel towers. Material cost of copper, lead, paper, jute, etc., and works cost for manufacturing same. Cost of excavation laying and reinstatement. Ducts, concrete, and paving. Sample estimate for short transmission lines.

TOWN LIGHTING AND POWER.

Definitions of load factor, station load factor, and diversity factor. Studies of load curves. Average and possible maximum efficiencies of power stations using coal, producer gas and oil fuel. Advantages and disadvantages of water power. Obsolescence of running plant. Usual values for depreciation of generating plant, cables, overhead wires, etc.

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My methods are somewhat unconventional. For example, I make a practice of distributing to the students catalogues and price lists which various manufacturers and contractors are good enough to send. I spend some time in commenting on any data in these catalogues and encourage the students to annotate their copies as a marked catalogue is so much more valuable than an unmarked one. Some catalogues are better than any text books, calendars, cable catalogue and Verity's Vol. I, being good examples.

Occasionally we make excursions outside. For example, to the Business Exhibition at the Olympia, where several firms gave special demonstrations of their apparatus and methods. One evening a representative of "Standardised Engineering Publications" came to the Institute and demonstrated the method of filing catalogues, and lists; whilst on another evening we went to the offices of Systems, Ltd., where the manager, Mr. Harrison, gave a most interesting description of card index systems and how to apply them to engineering work.

Last week my students were shown how to use the Patent Office Library in Chancery-lane, so as to enable them to make a quick search for a patent specification or for articles bearing upon any particular subject they wished to read up.

As the class work naturally means dealing with many figures and financial data which would require much time to copy out, I have adopted the plan of having mimeographed sheets. The students can thus give me their whole attention, and do not help spoil their handwriting by a hurried scrawling on notebooks.

Many useful matters which young engineers have to pick up at the present time in a haphazard way can be systematically taught. Certainly amongst them are such subjects as Quantities and Estimates. Shipping banking. Insurance. Commercial and Patent Law; The principle underlying the business routine. The nature and scope of agreements.

Young engineers need to know something of this last, if for no other reason than to save themselves from being improperly exploited by the company promoter type of individual, the City shark, who for too long has fattened on the engineering profession and brought it no little discredit.

Mr. Railing thinks that a certain period of engineering apprenticeship should be in the counting-house and in sales organisation. If it can be done, well and good, but as he himself points out, in Germany and America the seed is being put in by the teaching institutions and the selective work for picking out those who are best fitted to be the "trader engineers" of the future is being done very largely for the business firms by such institutions. One great difference between our methods and those of competitors abroad has been that our competitors got well ahead of us in recognising early the value of technical training. Even now it is not difficult to find employers in this country who think technical colleges are not wanted, and the mere idea of teaching commercial subjects systematically would no doubt shock them. Yet at the same time my own experience abroad has confirmed me in the opinion that the great want of the engineering profession is the expert and resourceful and tactful Trader Engineer. The man who is equally at home in a discussion at some local engineering meeting and in talking over financial matters with the manager of a shipping house or bank. Or, again, closing a contract with the safe money purchaser such as a Government or municipal engineer, or the long credit purchaser who happens to have impressed him with his business ability.

ELECTRICAL TRADES BENEVOLENT INSTITUTION.—At this season, when our readers are looking both back at passed twelvemonths' work and profits and looking forward to the coming year's prospects, we may appropriately remind them of the Electrical Trades Benevolent Institution and its useful activities. No doubt the secretary, Mr. William Davenport, will welcome any communications with suitable enclosures, sent to him at Ridler-place, Holland-street, Blackfriars, S.E.

WHAT'S WRONG WITH THE ELECTRICAL INDUSTRY?*

How to Put it Right.

By Mr. H. A. Carney.

It is generally agreed that the condition of the electrical industry in this country is far from satisfactory. But to what cause, or causes, this unsatisfactory state of things is due, has not yet been decided with anything approaching unanimity, and consequently no combined effort to improve conditions has so far been possible. It seems, however, to be generally assumed that all the trouble results from some great cause *alone*, rather than from the aggregation of a number of small causes, the effect of any one of which, taken alone, is of small importance. Probably this is the reason why, in the main, electrical engineers appear to be about equally divided in assigning all their troubles to

(1) The lack of enterprise on the part of the British capitalist, or to

(2) The English system of free imports.

Restrictive legislation, and labour troubles, are also urged as minor causes acting to retard development. It will be shown later that these points, while probably of some importance in themselves, are by no means the real causes of the trouble. Before entering upon a consideration of the various causes which are really responsible, it will be well to see, first, what is the exact nature of the complaint from which the electrical industry is suffering.

English manufacturers complain that competition, both among themselves and against the foreign firms who trade here, is extremely keen, with the result that prices are unreasonably low, while selling expenses are quite disproportionately high, these circumstances combining to reduce the percentage of profit almost to zero, and even in some cases to make it a minus quantity. That at present this is the net result of Britain's dealings in electrical goods for home and foreign use, is borne out by nearly every balance sheet issued by English electrical manufacturers. The reason given to account for the excessive amount of competition is, that the amount of work obtainable is insufficient to keep the shops occupied; that in most branches of the business there is not enough work to go round. This is a condition of affairs which must always exist at some period or other in an unorganised market, but in what way it affords a logical reason for an universal cutting of prices is by no means clear. That for some years past it has been the normal condition of the electrical market, shows that hardly a single firm has succeeded in attaining to a position of pre-eminence in the manufacture of any particular type of apparatus, since all are still struggling on with half-filled shops. It is particularly noticeable at times of more than usual stagnation in trade, that those firms feel the shortage of work most, who have a wide range of apparatus, and whose aim appears to be the ability to supply everything electrical. Such firms can only hope to do a moderate business in any one line, even in prosperous times. Undoubtedly the ability to supply every possible requirement of a customer, leads to an increase over the amount of business which would have been done, under the same conditions, if each department had been a separate firm, but this increase is obtained at the cost of the upkeep of an elaborate and usually very unwieldly organisation, the expense of maintaining which is practically independent of the amount of business being done. Only when the volume of trade is large—usually much larger than the firm's possible share of the available orders—does such a system begin to pay its way.

The electrical industry is at present unprofitable because, for the *certain minimum* of work available—on which continued prosperity depends—there are too many firms in competition for each to get such a share as would bring up their turnover to the minimum value at which the general expenses cease to be unduly burdensome and leave a margin of profit. The evil is aggravated, when some firm with an excess of "system," realising the shortage of work, tries to get a little more than its share by cutting its prices, thus leading to a general cutting all round.

* Paper read before the Manchester Students' Section, I.E.E.

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Why Work is Scarce.

Everyone agrees that work is scarce in the electrical business, but hardly any two engineers entirely agree as to *why* it is. After careful consideration of all the factors which influence the develpoment of the trade, the following appear to be the principal root causes of the present unsatisfactory condition. Strange to say, they are the reasons on which least weight is generally placed, yet they are causes which are at this very time active in perpetuating the trouble which they have already caused. Arranged in order of importance they are :—

(1) Apathy.
(2) Want of pushful development of electricity supply.
(3) Want of specialisation in manufacturing.
(4) Want of commercial ability in the electrical industry.

(1) Apathy.

The spirit of indifference is to a greater or lesser extent responsible for all the *relative* losses which British trade has suffered (so far few actual losses can be counted). To it may be attached a very large share of responsibility for the poor electrical trade here. In order to realise more clearly what this apathetic spirit has cost the country, take the case of the large gas engine industry which is closely bound up with the cheap supply of electricity, and consequently with the prosperity of electrical manufacturers. B. H. Thwaite was the first man to appreciate the great value of blast furnace gas and to devise means for utilising it. From 1894 until his death in 1908, he was continually trying to convince English engineers and ironmasters of the value of his schemes. The "Electrical Review" (December 25, 1908), referring to his work, says :—

> "What Thwaite saw in 1894 was a vision of England dotted over with large gas engines to use the millions of possible h.p. of gas that were going to waste. He lived to see a realisation of that dream, but it was in Germany. But for him there would have been no large gas engines to-day. The large gas engine had of necessity to be built to consume the large volumes of available gas, and so it is that Germany has to-day over 30 builders of large gas engines, and that since 1902, one firm alone has built or is building 247 engines, aggregating 308,000 h.p. A development in Great Britain similar to that which has already occurred in Germany would keep our engineers and our large electrical works well occupied."

At the risk of being tedious, I want to add another extract on the same subject, taken from a letter by W. H. Booth in the "Electrical Review" (February 5, 1909). He says : "Just as the great discovery of Dr. Perkins in the coal tar industry was rejected by our English chemists and became a source of high profit to the Germans, who had the intelligence and the prescience to adopt them, so it has happened to Thwaite's invention. The Germans have again turned a weapon forged, by an Englishman, against ourselves. The gulf between their iron and steel industry and ours is being widened by the economic advantages which they quickly saw and as quickly seized when the invention was made known. When they suddenly found themselves possessed of energy representing 1,000,000 h.p., they lost no chance of diverting such a fine asset into various useful and highly profitable channels. The proof of this is, that over half a million h.p. is in operation, derived on lines suggested and proved practical by Thwaite. Out of our 700,000 h.p. in Great Britain, we have utilised a little over 20,000 h.p., or 5% of Germany's figures."

These extracts and these figures render all defence useless. Why are such opportunities lost by this country ? Because British engineers persistently refuse to appreciate the latent possibilities in a new abstract idea. The capitalist and the manufacturer is guided by the opinion of the general body of engineers, and gives them credit for knowing their own business, and for being sufficiently broad-minded to judge new ideas by sound logical criticism and not by mere prejudice. If the general body of engineers condemn a new idea by loudly pointing out all its demerits and saying nothing as to its merits—as is their rule—is the capitalist to be blamed for refusing to risk his money in a scheme which, what passes as expert opinion considers freakish ? Certainly not. It must be admitted by the unbiassed, that until the scheme which he is asked to finance has received engineering approval, or been shown by experiment at home or abroad to be sound, he cannot be accused of being unenterprising if he refuses to consider it. What the financier took to be "expert opinion" was really nothing but mere off-hand impressions on a problem of a very complex nature, hastily studied and usually very imperfectly understood. Nothing but a more broad-minded attitude towards new ideas, together with their more careful consideration before taking sides, will correct that rash judgment and the damaging and unjust criticism based upon it, in Institution discussions and elsewhere, which is the principal cause of England's lead in engineering matters being steadily reduced.

The case of the large gas engine industry has been taken as an example, but the same strange holding back is found in nearly every branch of electrical engineering. It is the common experience of English industry in general that many ideas suggested here by Englishmen and rejected have not only founded enormous industries for other nations, but have also led to the foreigner becoming supreme in all engineering matters, both in design and machinery, connected with these industries, thus making the British loss a double one. While the unsympathetic, and often even bitterly hostile, reception of new suggestions by the engineers of this country chilled off our manufacturers who would otherwise gladly have spent their money and adopted the ideas, the foreign engineers lost no time in pointing out to their own manufacturers all the good points which they possessed, with the result that the foundations were laid of most valuable new industries even now practically unknown in England.

(2). Slow Development of Electricity Supply.

While the expense and difficulty of obtaining Provisional Orders and special Acts of Parliament to authorise the establishment of new undertakings for the supply of electrical energy has to a slight extent tended to keep the number of such supply undertakings small, it affords no excuse for the slow growth and development of those which have been started. Although the central station engineers of other countries—particularly America—have for years regarded the supply of electricity as being as much a business as the manufacture and sale of, say, machinery, and have applied the same business principles of development to it, it is only just now that anything like a serious effort is being made in this country to push the use of electricity, on commercial lines.

This backwardness is the result of several causes :

(1). The absolute monopoly granted to supply authorities.
(2). The management of the undertakings by men whose commercial training has been fortuitous and incidental to their engineering training.
(3). The control of municipal electricity committees.

The result of granting absolute monopolies—which in some cases are admittedly necessary inducements—is to remove the necessity of making strenuous efforts to secure at once every possible consumer, before he is obtained by a competitor. In the case of supply companies, the monopoly is not so injurious in its effect as it is in the case of municipal undertakings, because each shareholder makes it his business to impress upon the directorate his desire that development may be rapid in order that his dividend may increase. In the case of the municipal undertaking, the average ratepayer takes very little interest in the finances of the local supply, and so long as its existence saves him a few pence in the pound on his rates is quite unconcerned as to whether those few pence would be better invested in extensions of the supply, so increasing its earning capacity and its ultimate relief to the rates. Thus in this case the management is seldom pressed to find new openings for business ; in fact, in some cases, municipal committees have been known to refuse substantial loads, rather than increase their plant capacity to deal with the increased demand. At a recent Local Government Board enquiry into an application for borrowing powers in connection with central station extensions in a small manufacturing town, it was stated that during the previous two years over 2,000 h.p. in motors had been refused, as the existing plant capacity was insufficient ! The reason given for making the application even at that late stage, was the fear that some power company, seeing the rich harvest awaiting an enterprising supplier, might

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succeed in upsetting their monopoly on the ground of inadequate supply—a most businesslike reason to give for not extending an undertaking to the fullest extent! While any commercial enterprise must produce better results when its development is directed by a man of considerable commercial experience, than when directed by an otherwise capable man without that experience, yet so far as the working of existing supply business is concerned, the average chief electrical engineer seems to obtain excellent results. As far as the systematic development of new business on some definite plan is concerned, electrical engineers—with a few notable exceptions—show great want of enterprise. It is difficult to say how much blame really attaches to the engineers and how much to the electricity committees. In some cases, officious and incompetent chairmen undo all the work of their engineers—an unsatisfactory year's working may sometimes be thus explained. The supervision of a trained electrical engineer in the management of his department by a small body of untrained men, in the great majority of cases incompetent and helplessly ignorant of even the elementary principles and economics of electricity supply, is ridiculous, and is a condition of affairs only possible under municipal control. While the bulk of the supply in this country is in such hands it is hopeless to expect anything like the development which might reasonably be expected, and which ought to be taking place. In most cases at present whatever development takes place in the supply, takes place in spite of the "control" of the electrical committee, and not as a result of any help which it renders to the engineer.

If the engineer were made solely responsible for the success of the undertaking under his charge and was answerable to the Council as a whole, and only as a whole, for the use he made of his powers, there is not the slightest doubt that an enormous development would take place in a very short time, for then the engineer would have every inducement to push the supply to its fullest extent, without any interference, and by whatever means within reason seemed to him best.

While the power supply business has been fairly well developed, so far very little progress has been made in the popularising of electricity for cottage lighting and domestic heating, cooking, and light motor work. Full advantage has not been taken of the metallic filament lamp to develop this field—which is the least likely to vary in its demand, with fluctuations in the state of trade, and which, therefore, must provide something like a definite steady minimum of work in renewals and repair parts, that would be of the greatest help to the manufacturers of those parts, in keeping their shops running during periods of industrial depression. Instead of hailing the metal filament lamp as the means of defeating the gas mantle on cost of illumination alone, and so opening up the whole field of lighting previously held by gas, complaints were loud against its introduction. It is probably due more to the necessity of maintaining the previous station output, than to any serious desire to quickly develop new ground, that engineers and supply authorities have begun to take up publicity schemes.

While really a minor point, the outcry of the contractors against the efforts of supply authorities to get new consumers to the mutual benefit of the station and the contractors shows to what a degree the unenterprising spirit pervades the whole business of electrical contracting, and makes it very clear that in whatever scheme is devised for boosting the suppliers of electrical energy, the wiring contractors must be included.

(3) Want of Specialisation in Manufacturing.

One of the reasons advanced against the more extended use of electricity for the many purposes for which it is eminently suitable, is the comparatively high cost of the necessary plant and apparatus. One of the reasons given by manufacturers for this high cost, is that the material is not ordered in sufficiently large numbers to be made in the most economical manner. This is a perfectly satisfactory reason from the point of view of the manufacturer who sets out to make everything electrical, and who must therefore be content to get a few of the orders going for each class of apparatus. Such a manufacturer obviously does not lay himself out to corner the market in any particular branch of the business, and it is not to be expected that his cost of production in any particular plant will compare with that of a manufacturer specialising in and entirely dependent on that particular kind of material. However valuable the "supply everything" type of firm may be in assisting the development of huge schemes and in making the entire plant required for such developments, their departmental competition in the open market with smaller firms specialising in the various branches, can only be carried on under the difficulties of smaller output and higher overhead charges than the smaller firm has, and consequently at a reduced profit, if any. This departmental straining after orders for orders' sake is one of the most common causes of price cutting, since it develops the practice of "assisted free samples," or the selling of material at or below its bare cost price, in the hope that once in, all future extensions will be obtained—but at a sufficiently good price to make up the initial loss. The effect of such methods is to throw the whole market into confusion and incite price-cutting all round; but here again the specialist, with his larger production, is still in a better position, comparatively.

Few, if any, electrical firms have so established themselves in the production of any particular kind of apparatus as to be quite free from the common practice of rushing into the manufacture of the various other classes of goods for which, in the course of the rapid developments to which electrical engineers are accustomed, there arises temporarily a very great demand. To supply this sudden demand, firm after firm enters the market—most of them equipped with nothing better than low prices and poor stuff. The result is that in a very short time the particular market is overcrowded, and prices having been rapidly cut by the advent of the low-priced but inferior material, remain at an unprofitable figure, while further competition takes place among the manufacturers on the basis of improved designs for the same low prices. If, when this stage is reached, the total demand does not fall off, or the fashion change, the manufacturers are lucky. It is the common experience of firms who rush in to supply a demand outside their usual line, that their business in their own branch drops off very nearly directly proportionally to the trade they are doing in the temporary line, and this not because its total demand has fallen, but because they have been giving it the divided attention of their works and sales organisations. This undertaking of what is really casual work, because for the moment it appears to be more profitable than the steady line, is, perhaps, the most direct cause of the price-cutting, the over-production and the over-capitalisation—because badly distributed and employed—which characterise the electrical manufacturing industry in this country at the present time. It is the result of two things—want of a well-defined plan of development for the type of material they regard as their main business, and an unthinking greed for immediate gain even at the risk of future loss.

Specialisation does not mean stagnation; it simply means the concentrating of a firm's whole attention on the one or two lines of electrical apparatus for which, by the experience of its staff, or its trade connections, it stands the greatest chance of becoming the leading maker. The guiding rule by which electrical manufacturers at present shape their plans seems to be the attempt to get the greatest immediate return at the moment by following the changes of the casual markets—trusting to their agility to avoid ensuing losses, rather than the steady development of some specialised branch of the business, and the subordination at all times of all other trading interests to it.

(4). Want of Commercial Ability in the Electrical Industry.

There are, of course, some brilliant exceptions to the above statement—it is open to every one to believe himself to be one of the exceptions.

Taking it as a general rule, it may be said that the electrical industry does not appear to have attracted the very foremost commercial men of the country, as some other industries have done. This is probably at once a reason and a cause; the men have not come because the results they have seen from without have offered no inducement to them to do so, while the results are what they are because these men have remained outside. The commercial directors of manufacturing firms, failing to realise that there is much to be done in putting the selling organisation in order, usually devote an excessive amount

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of time to putting the works in order and dictating the requirements of the market to-day to the designer who probably better than anyone else sees the trend of future developments and can, therefore, make the best provision for the present. It has been repeatedly shown that taken on over-all merits and in detail, the designs of British electrical designers are collectively equal to and often far surpass those of foreign makers; if they are sometimes a little more expensive in first cost, they are always worth the money paid for them—which is more than can be said of some foreign machinery. Why then do they not command the home market, and not only the entire home market, but the markets of the world? Because, although the goods are unsurpassable, on the average, in very few instances indeed is the customer made to realise the fact. The customer's dealings are at present with men who are merely ordinary salesmen, all right for selling a non-technical commodity, but quite unable to clearly understand and point out to him just exactly where their design surpasses all others, and why it does so. Of what use is the perfecting of designs, if the salesman is not able to convince the customer of their excellencies? The prosperity of any article of trade depends first on the selling ability of its salesmen and secondly on its quality. The highly profitable business of "patent" medicines, for instance, has been built up in most cases on a foundation, 99% salesmanship and 1% value. Manufacturers, finding themselves so undeservedly unsuccessful in the home markets, have neglected to push foreign trade with anything like the energy which its development requires, and it is simply due to this fact that English electrical manufacturers are not getting their share of the world's trade, in the same way as English textile manufacturers, for instance, are doing. Wherever an English firm has taken the trouble to develop export business—that is on correct export business lines—the results have in every way been most satisfactory. In one or two instances, in my experience, the export business of electrical firms is of larger volume than the same firms' home trade.

The Minor Reasons.

Having briefly run over the principal causes of the present unsatisfactory position of the English electrical manufacturing industry, some reference must be made to the other causes which have from time to time been advanced to account for it. The cause of the capitalists' lack of enterprise has been dealt with already. While not wishing to enter upon a seasonable controversy, I want to point out a reason why, in the circumstances, theoretically at any rate, the system of free imports should not hurt an industry which was really healthy. A firm manufacturing in England, should, one would think, be able to sell here cheaper than a firm manufacturing the same goods to the same designs, say, in Germany, and having to pay the cost of carriage on their shipment here. If all were right the carriage charges would seem to be quite a sufficient burden on the foreigner, especially when it is remembered that a large proportion of his raw material passes through England to make abroad, the machines which are afterwards sold here. I am aware, of course, of the modifying effect of the excessive freight charges by English railway companies compared with the much cheaper cost of carriage by sea, and the low rates charged by State railways abroad, but allowing for all that and the cheaper labour of the foreigner, there is a discrepancy which can only be explained by an existing unhealthy condition of the English electrical industry. This point seems to be borne out by the fact that both German and American firms have established works over here. Restrictive legislation is the result of a badly informed public opinion. All laws come from the Government, and the Government rests on the will of the governed. Show the governed that it is suffering from some action of the Government and the law will be quickly changed. When the public have had the gospel of electricity for all purposes preached to them, as they should have had it preached long ago, they will very quickly have the laws amended. Labour troubles have not seriously had anything to do with the comparatively backward state of the industry in this country.

Before leaving the question of minor causes, some reference is required to the doubtful wisdom of price-cutting as a means of filling the shops when the demand is slow. Every quoted price is the sum of three items—prime cost, overhead expenses of selling, designs, rent, rates, etc., and profit, and of these both the first two must be actually covered to avoid a loss. Take the case of a motor usually sold at £100. Assume that £10 is profit, £60 prime cast, and £30 the value of overhead expenses. If with the hope of getting more of the limited number of orders available (for it was the limiting of demand which made price-cutting necessary), the price is quoted at say £80 (a 20% reduction for the sake of argument), the seller has really incurred a debt, at least for the time being, of £10 to his overhead charges account, and only by his selling three motors at £80 each, instead of two at £100, can he possibly pay off his general expenses and avoid the loss. Even then he makes absolutely no profit. The point is, if every firm would keep up its price and simply make more strenuous efforts to get the two orders at £100 each, the same result would be got, and more profit made, than by cutting the prices. It means, however, everyone keeping up the prices in their own interest.

What we Want.

Before considering how to put the industry right, we must first understand clearly what we mean by right: is it to be high prices with in many cases a smaller amount of business than might be got, or low prices and a much more rapid extension? Experience would seem to show very clearly that low prices are a necessary preliminary to extended developments. The first cost of electrical apparatus and machinery has always been a great cause quite apart from other causes, of their non-adoption in competition with gas for lighting and with gas and steam in some driving schemes. Cheaper prices are entirely a matter of the number of pieces made. It is very much the same as the cost of printing; there is very little extra expense in printing 1,000 copies over the cost of printing 200.

How to put the Industry Right.

This will have largely appeared from a perusal of the foregoing. In the first place, new ideas must be encouraged. Suppose that in contrast to what actually happened, English engineers had carefully studied, for example, the scheme put forward by Thwaite, and, appreciating its great possibilities, had expressed in emphatic manner their general approval and pointed out the great benefits it would confer on British industry, can it be doubted for one moment that the iron masters and the capitalists would then have hesitated to consider proposals for its practical introduction, and that the necessary capital would not have been as readily subscribed as it is for working highly coloured schemes—with foreign machinery—in semi-civilised lands?

If this had been the reception of the idea, then England would have been the home of the large gas engine, as it was of the steam engine: the English electrical industry would have flourished, and perhaps the German electrical industry would never have attained its present magnitude; the English iron and steel trade would have been much strengthened, and in consequence would have found additional work for the electrical industry.

The electricity supply must be pushed in every possible way. With the new lamps there is no excuse for the bad state of the trade. I do not put it forward as a serious suggestion, but I have sometimes wondered what would be the effect if everyone engaged in every branch of electrical industry were to band themselves into a society to propagate knowledge of electricity and its uses in much the same way as political parties spread their opinions. I rather think if the idea were enthusiastically carried out that we should very soon have rapidly growing central stations springing up everywhere in the country. If costs of production are to be cheapened, then it is absolutely necessary that production should be in larger quantities than hitherto. Thus home manufacturers would be better able to compete with the so-called "dumped" goods, and might find themselves in a position to do a little dumping on their own account. As the amount of work is at present limited, it means that instead of rushing into competition, firms must gradually drop lines in which they feel weak and develop other lines in which there is not the same amount of competition. Firms must one and all tend to leave a field in which there is competition, and not, as at present, rush into it. The effect of firms each radiating

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out from a common centre where they are all at present concentrated in the deadliest competition, must have very beneficial results not only to the firms who strike out on new lines, but to the whole industry, for it will allow of the energy which at present is being expended in internecine warfare being released to extend the uses of electricity and hasten its application in all the other branches of British industry, to the greatest benefit of the whole country.

The greatest thing, however, and one which can do more by itself than any other single means, is the production and use at the very earliest moment of thoroughly commercially trained engineers, and of thoroughly technically and practically trained commercial men, as salesmen.

I believe there is nothing needed to make the British electrical industry the greatest electrical industry of the world, that electrical engineers cannot supply themselves; they need no assistance from any government, home or foreign, to help them; they can do it all themselves, if only they will replace their apalling apathy by confident enthusiasm and the determination to win their rightful place. The golden rule, then, is firstly, to inspire confidence in the capitalist by making him realise every merit which a new idea may possess. Secondly, to force on as rapidly as possible the universal use of electricity. Thirdly, to avoid competition by dropping the "beggar my neighbour" policy; and fourthly, to make the prospective customer realise the full value of the goods which the English electrical industry offers him, by dealing with him through technical salesmen. The combination of these four things will, if carried out, work that change for the better in the industry which we are all so anxious to see accomplished.

There are many other points which time does not allow of my touching upon. In the above remarks I have confined myself to what appeared to be the root causes, and those which can be removed by the cumulative effect of individual effort.

(Discussion will follow next week.)

DETECTORS.*

By A. H. Johnson.

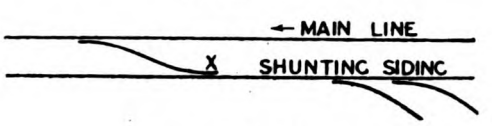
"Detection" is one of the several functions into which railway signalling is arbitrarily divided. Broadly speaking, the whole interlocking system is a detection system; but, in speaking of "Detection," we mean the method and means by which we prevent the signals of any route from showing false security in the event of switch points failing properly to correspond with the movement of the levers at the signal cabin.

In the early days of railway working the need for detection was not fully proved, in fact, facing points were not even protected by a facing point lock. On the introduction of the facing point lock it was thought that detection would be sufficiently performed by the bolt, and we all know that many failures of the points have been, and are now, often detected by the facing point lock. The point lock, however, is far from being a good detector, for the points have sometimes remained completely over in the wrong position, and the point lock has plunged them in that position. Many trailing points are at present devoid of a facing point lock, and this fact, taken in conjunction with the spread of the indiscriminate and unfortunate practice of using one ground signal to answer for several routes, makes detection in such cases a matter of great difficulty if attempted by ordinary mechanical means, where several pairs of points are involved, indeed, so much so, that in many cases the detection has been omitted. The danger to be anticipated from the lack of detection is not confined to points over which passenger trains run in a facing direction. On the contrary, a great risk attends trailing points in some cases, especially those over which shunting takes place. This is due to the fact that a shunt made over a misplaced trailing point would, in many cases, be nearly sure to foul the main lines. For instance, such a case in connection with points *x*, fig. 1, might easily prove disastrous to a fast train.

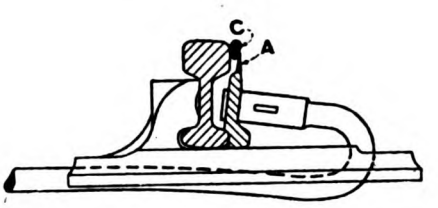
*Paper read before the Institution of Signal Engineers (Incorporated).

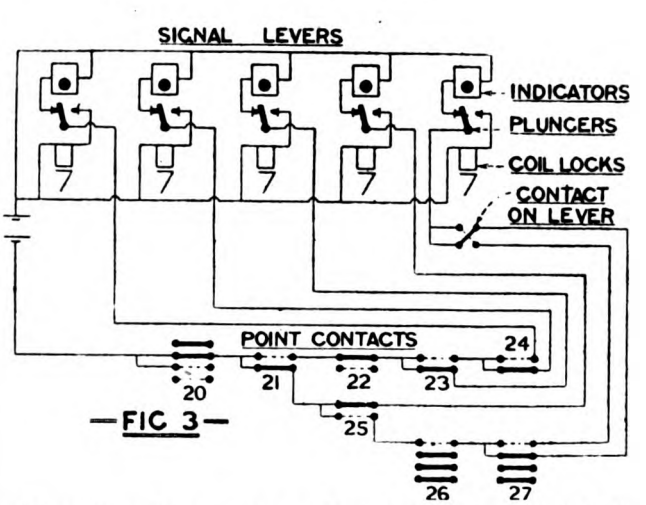
After practical experience had proved the need of detection, the first detectors installed consisted of bolt locks connected in the run of the signal wire. Now, in cases where the signal could be fixed near the points, this device proved fairly efficient as a detector, and it is largely in use to-day, but signals have been held in the "off" position owing to the bolt lock binding in the point connection. In a complicated group of points, this method has been attempted, but with very poor results, owing to the difficulty connected with varying temperature. The use of a wire-adjusting screw is very apt in such cases to pull the nearer bolts into the gap in the point connection. There is also the extra chance of the sticking of the signal connection, when it has to thread, so to speak, through a group of points. In this method, in common with all systems of detection, there is the difficulty of keeping the detector bolt accurately adjusted to the ever broadening gauge. This gradual broadening of the gauge takes place even when half-inch tie plates are used, and it is a very real difficulty affecting accurate detection. It should be remembered that a point tongue cannot always be protected by a set in the stock rail, and an opening of one quarter-inch has derailed engines having worn flanges. The flange simply uses the point as a ramp, and climbs up and off.

FIG. 1.



—FIG 2—





—FIG 3—

There have been many patterns of detector bolt lock, some detecting both point tongues and others only one. Other patterns have detected both tongues and the bolt of the facing point lock. Some bolts have been counterweighted as a sort of antidote for temperature troubles.

From about thirty years ago till quite recently numerous attempts have been made to meet the detection of facing points by what is known as the "Facing Point Lock Detector" method. In this method the facing point lock itself is so designed as to become fixed and immovable should the point tongues fail to correspond correctly with the point levers.

There are several designs of this apparatus, and the means employed consist generally of a duplex bolt and gearing for causing the reversal of the bolt action when the point lever is reversed. The various designs are well known to those whose experience goes back, say, fifteen years. They can be found in the old catalogues of McKenzie & Holland and Saxby & Farmer. In one of the later designs a single action bolt is so geared that it requires a complete reversal of the points after each withdrawal from the

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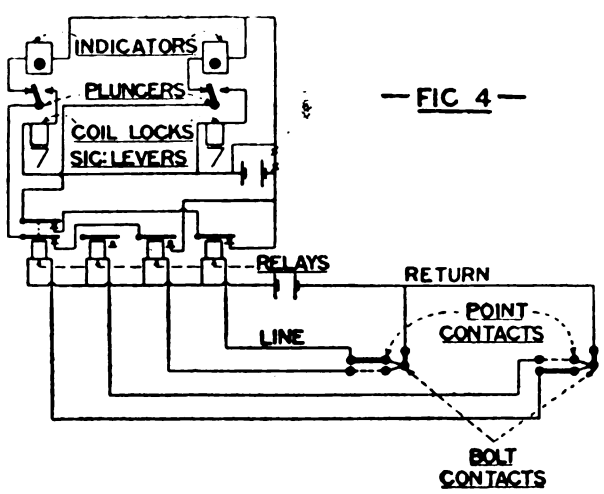
stretcher bar. It is ingenious and simple, but the necessity of reversing the switch points each time after unlocking would preclude its use in many cases.

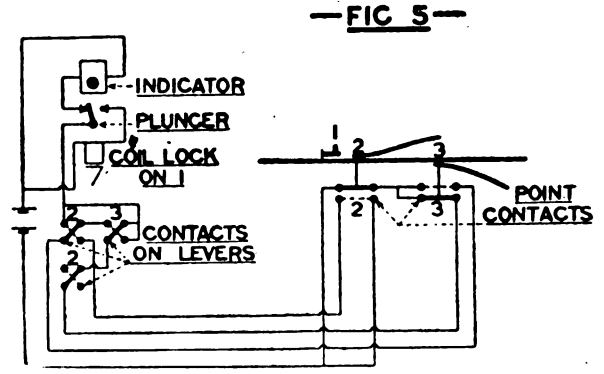
It may be mentioned, in passing, that the facing point lock detector method is used in some of the power signalling systems.

Another scheme which was tried on the Lancashire and Yorkshire Railway, about 29 years ago, consisted of springs applied to the point tongues to throw them half-cock should the point connection fail. Needless to say, the signal engineer removed them after a short trial.

Those who have not had close touch with the upkeep of railway signalling are apt to think that the "F. P. L. Detector" method of detection is efficient enough, but experience proves that nothing short of direct detection of the point tongues themselves by means separate from the facing point lock should be used, owing to the growing importance of this feature of signalling by reason of the ever-increasing traffic. The risk is thought to bear some relation to the number of train movements.



—FIG 4—



—FIG 5—

Some of the more recent power-signalling schemes embody direct detection of both point tongues, and some go further and provide what may be termed "Continual Detection," inasmuch as the detector serves to detect any displacement of the points, at any time subsequent to the regular check-lock detection, performed when the signalman uses his operating lever. This "Continual Detection" is a most valuable feature, and in the opinion of the Author it will, in course of time, become standard.

Some of the difficulties connected with the practical upkeep of detection performed by ordinary mechanical means have been mentioned. These drawbacks have induced some signal engineers to try electrical detection in connection with manual plants. Some difficulties are thereby removed. For instance, varying temperature is no longer an obstacle, and there are no parts which may hold the signal in the "off" position. Electrical detection has been applied to the whole of Waterloo Yard for about seven years, and we have thereby remarkably reduced the services of the heavy lifters at that yard. Electrical detection has, however, difficulties of its own, although they are not so hopeless as those connected with mechanical ones.

At first sight it may appear that any circuit closer or electric switch, designed to withstand the heavy vibration in the vicinity of railway rails would, in connection with an electric circuit and an electric lock at signal lever, be all that is required. But, as a matter of fact, every electrical contact requires a definite margin of movement after actual touch is established. The result is that those which have been tried by the author cannot be set to detect the points quite so finely as a mechanical bolt. Then, again, there is generally a sinuous movement of the rails, in a horizontal direction, under the wheels of a train at many switch points, which rapidly wears the contact surfaces of the detector. The author found that to counteract these weaknesses requires constant care at a busy yard. It must be admitted, however, that as much care is needed in the adjustment and renewal of mechanical bolt detectors, at equally busy places, if they are really kept efficient.

There is one part of the point tongue that is of vital importance, as regards safety, in its relation to the stock rail. This is the portion *A*, fig. 2. When the point stretcher bars and fittings become slightly worn, it is found that an obstacle such as shown at *C* will cause the top of tongue to remain open while the bottom closes against the stock rail. A twig or a piece of hard snow will do it. Now, the rod connection to the detector is attached to the centre of the point rail or to the base of same, with the result that when the point rail is tilted, as shown by fig. 2, the detector fails to detect the opening at the rail top. This applies, of course, to both mechanical and electrical means of detection.

Another question calling for serious consideration is that of providing good underground wire work at a moderate cost. At the Waterloo Yard detection seven years ago, the author used single lead-covered wire in cast-iron pipe, and it is found durable and free from trouble. It was very carefully installed. At Clapham Junction, the author is using lead-covered wire, in bitumenized fibre pipe, for the main runs, and in iron pipe for connections transverse to the rails.

There are two principal methods of laying out the wiring for electrical detection, viz. :—

1. Taking the circuit of the signal lever lock through a contact box at every pair of points affected.
   This method needs multiple contact boxes, which is objectionable.
   Fig. 3 shows diagrammatically this method as applied to Waterloo.
   The diagram shows a small portion of the detection at this yard. Attention is drawn to the multiple contacts at points 20, 26 and 27.
   In some cases there are twice as many contacts as at 26.
2. The provision of a two-way contact box at each pair of points; wires from each to the signal cabin; a multiple point relay worked by that circuit and the governing of the various signal lever locks locally therefrom.
   Fig. 4 shows the method as applied by the author.
   Instead of two line wires and two relays serving each pair of switch points, the author sometimes uses a single line wire and a polarized relay.
   A combination of schemes 1 and 2 can be used for sake of economy. In that case, scheme 2 is used only for those switch points at which scheme 1 would necessitate more than a two-way contact.

The electrical detection method for Power Signalling is substantially the same as scheme 2 in most cases, although No. 1 has been used.

The reasons which lead the author to prefer the second of these methods are that the contact box at the points is simplified down to a uniformity of two circuit closers, and the multiplication of the circuits takes place at the signal cabin, where they are less liable to give trouble than in ground work. Another great advantage is the uniform wiring to each pair of points.

Electrical detection has an additional advantage inasmuch as with a single signal answering for several routes, the actual route corresponding to the point lever positions can be detected. This is done by simply passing the detector circuit through circuit closers working with the point levers as shown by fig. 5. If the lever circuit closers are omitted of course the exact route is not detected.

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Before closing this paper, the author would like to draw the attention of the Permanent Way Department to the very practical need there is for improved switch point fittings, such as gauge plates which will really keep the rails to gauge, and stretcher bars which will stand for a reasonable time without attention from a blacksmith. The present fittings are little better than those used when the rolling loads were half what they are now and the train movements far less.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways, and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

QUESTIONS.

Question No. 1236.—Two rotary converters, each having six slip rings (diametrical connections), four poles, 60 kw. 250 volts, supply power to a three-wire D.C. circuit. Each rotary is connected to three single-phase transformers, the middle points of the secondaries of which are joined together to the neutral of the D.C. supply. It has been found that the commutator segments, being in all 288, got black in the following order:—33, very bad; 4, good; 20, very bad; 90 good; 30, very bad; 4, good; 20, very bad; 87 good. The commutator of the other machine got fairly black at two diametrically opposite points. The commutator was turned but after a few days' run black segments appeared in both machines in two diametrically opposite sections, corresponding to the 33–4–20 and 30–4–20 previous bad segments. Although the machines run at 260-265 volts instead of the rated 250 volts, sparking is inappreciable. What is the cause of the above?—"N."

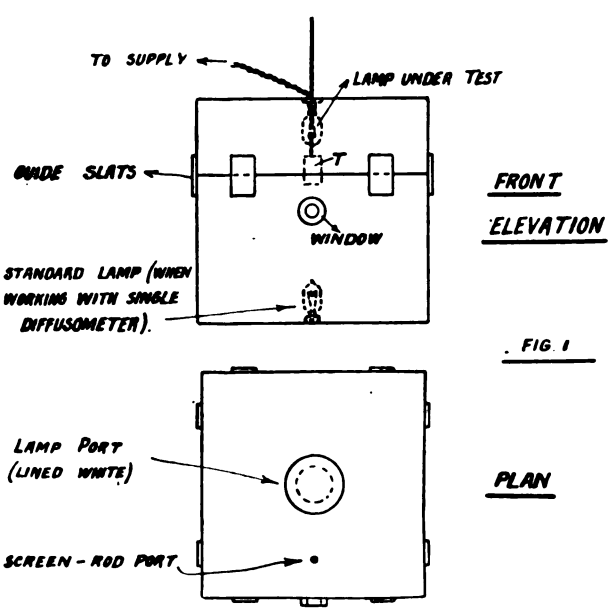
Question No. 1237.—State the pros and cons in using electric traction on railway sorting sidings and terminal goods stations. Which has the greater advantage in such application, continuous or single-phase, bearing in mind that the same supply would be used for working the cranes and for lighting? What would be the most suitable voltage?—"ELECTRIC."

ANSWER.

Question No. 1234.—Explain the theory, construction and use of diffusometers in the photometering of various lamps. State the limitations of the apparatus (inherent and practical). I think of using a cubical form instead of the usual sphere, how will this affect results? Will secondary standards be necessary? Comment on the use of translucent screens in photometry (especially in the measurement of high candle powers).

Answer to Question No. 1234 (*awarded* 10s.).—It can be mathematically proved that if any source of light (however irregular its distribution) be suspended within a sphere lined with a "dead" or "matte" white substance the illumination falling on every part of the latter is of equal intensity so long as the directly incident illumination be cut off by an opaque screen. Now the mean spherical candle-power of a lamp is the candle-power which would be emitted in every direction by a source having perfectly uniform distribution and giving out the same total amount of light as the actual lamp concerned. It follows at once, from the above remarks, that the illumination on the inner surface of a spherical "lumen-meter" or "diffusometer" (as the apparatus is called) is proportional to the m.s.c.p. of the lamp illuminating it.

To utilise this fact a small hole (1″–2″ diameter) is cut in a convenient part of the spherical surface and closed by a ground glass screen which is protected from direct illumination, by the tested lamp, by an adjustable opaque screen within the chamber. This small window, thus illuminated, is photometered in the ordinary way (say by Lummer-Brodhun photometer) and the ratio of its candle-power to the m.s.c.p. of the lamp within the diffusometer (i.e., the "reduction factor" of the instrument) is determined by suspending a lamp of known mean spherical c.p. within the chamber and noting the c.p. of the translucent screen. Great care must always be taken to avoid direct illumination of the latter, and, as there is a perceptible change in the reduction factor of the screen (see later) when lights of very different colour and intensity are compared, it is well to determine the "constant" of the diffusometer for each class of lamp as far as possible.



It can also be shown mathematically, and verified by experiment, that a cubical diffusometer cannot give such accurate results as the spherical form, but there are many reasons for seeking to replace the latter by the former. A well-made spherical diffusometer, some 6′ to 12′ in diameter, built up of lined metal sectors, or of plaster of paris laid on to a wooden or steel frame, is a costly apparatus and one which is, by its size and shape, very awkward to manipulate.

Bearing these limitations in mind, the writer carried out a series of experiments, a few years ago, to determine whether a cubical box (about 3′ side) suitably lined, could not replace the usual, and theoretically desirable, sphere. The cheapness and convenience of such an arrangement is obvious. The general construction employed was as in Fig. 1: for testing incandescent lamps the box was lined with clean white blotting paper, but for some arc lamp tests it was found necessary to line the box with tin plate. To give the latter the requisite matte white finish it was painted with white enamel, which was, when nearly dry, heavily dusted with plaster of Paris, chalk, or, best of all, zinc white. The box was made to lift apart centrally for easy access to its various fittings.

In an experimental cubical diffusometer a number of "windows" were cut in various parts of the box, all except the one actually in use being closed by whitened plugs. By running a standard glow lamp inside the chamber and measuring the illumination at each of the experimental windows in turn (all direct illumination being cut off by an adjustable opaque, white-papered screen), it was found that the illumination was by no means equal all over the inner surface of the box. The cubical instrument could, therefore, not be used in the same simple manner as the spherical diffusometer (see also later notes *re* screen behaviour).

By using two precisely similar cubical diffusometers, however, provided with central "windows" (Fig. 1), closed by translucent screens of as nearly as possible similar optical properties, tolerably accurate results could be obtained, by placing a standard lamp of known m.s.c.p. in one chamber and the tested lamp in the second box and

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photometering one window against the other (by aid of an ordinary optical bench and Lummer-Brodhun photometer). It is easier and more accurate to find an optical balance between two similar, translucent screens than between one such screen and a naked standard lamp: to improve the accuracy of the above method the screens should be interchanged and a mean balance point thus determined.

Screens.—Even under the above revised method of using cubical diffusometers it will be found that somewhat unsatisfactory results are obtained when comparing lamps of very dissimilar characteristics owing to variations in the effect of the translucent screens. (This applies also to spherical diffusometers unless the source of error be avoided by directly measuring the incident diffused illumination on the window aperture without the interception of a translucent screen.) The optical transmissive properties of a ground glass, tracing paper or other translucent screen appear to vary distinctly but in a very complicated manner with the intensity and colour of the incident light: this effect can never be allowed for satisfactorily, and constitutes, in some cases, a serious error. Again, the law of inverse squares does not hold at all well for luminous-screen sources of illumination; this law, strictly speaking, applies only to illumination received from point-sources—no doubt it would apply fairly accurately to screens giving out light in a series of normal ray-cones (Fig. 2a), but as a matter of fact the real source of light, *s*, is behind the screen, and the diffused light from the latter is really due to the variously inclined bundles of rays (see Fig. 2b) into which the incident rays from *s* are diffracted.

The above two factors make the photometry of diffusing, translucent screens a hazardous matter. Such screens have been employed in attempts to determine the candle-power of searchlight beams (definite areas of translucent screens placed in front of the lens being photometered against a suitable standard lamp). Though such experiments enabled an approximate determination of the enormous candle-power of these lamps—possibly the most accurate estimate which has yet been effected—the tests, on the whole, merely accentuated the restricted application and limited accuracy of the methods employed.

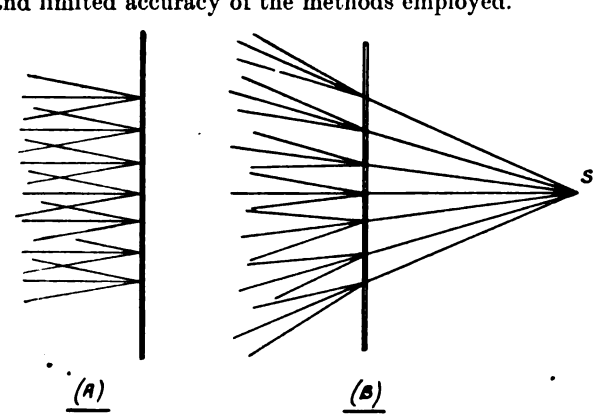

FIG. 2.

It will be apparent from a consideration of Fig. 2b that the further the source *s* is behind the screen, and the smaller the latter, the more accurately will the law of inverse squares apply to light treated as emergent from the screen as source. The writer's cubical diffusometer tests, referred to above, showed that photometry of the translucent screen of a single box against an ordinary standard lamp (instead of against a similar diffusometer screen) would give no consistent results. Thus the ratio between the m.s.c.p's. of a certain arc lamp and incandescent lamp was known (by independent integrating photometer tests) to be 50 : 1—the cubical diffusometer gave a ratio of 5 : 1 only: In another instance the known ratio was 16 : 1, but the diffusometer showed only a $3\frac{1}{2}$: 1 ratio. As illustrating the same facts, it may be noted that, whereas the m.s.c.p's. of a certain flame arc, with and without its globe, were 300 and 360 c.p. respectively, as determined by the diffusometer, the corresponding values determined by an integrating mirror photometer (of known accuracy) were 850 and 2,800 c.p. respectively.

When testing flame arcs the milky fumes which rapidly collected in the diffusometer box were found to appreciably reduce the values found for the m.s.c.p. (incidentally, these fumes are very uncomfortable to the experimenter's throat). The intercepting screen (T, Fig. 1) should be no larger than is necessary to cut off all direct illumination from the "window," and it, like all the other internal fittings of the diffusometer, should be papered or painted a dead white.

If "City" has only a few lamps to test, I should advise him to employ the "point-by-point" method of determining their m.s.c.p. (i.e., determine the actual c.p. in 10 or 12 directions in each of 10 or 12 diametrical planes, then averaging the results obtained), or, if available, he may use a properly graded and calibrated mirror integrating-photometer. In the present state of their development spherical diffusometers can hardly, and cubical diffusometers can certainly not, be regarded as cheap, accurate or convenient means of commercially determining the mean spherical candle-power of lamps.

"LUMEN."

THE INTERNAL COMBUSTION ENGINE.

At the Institute of Marine Engineers, Mr. W. P. Durtnall read the second half of his paper on "The Internal Combustion Engine." The author described minutely the various details of an internal combustion engine using oil as fuel. The advantage of off-setting the cylinder was pointed out and torque curves were given showing the advantage of having six lines of ports. He drew attention to the fact that quick revolution engines exhaust their gases at fairly high pressure and he thought that such gases could be used to drive low pressure gas turbines. Already such exhaust gases had been used to drive an auxiliary rotary engine.

The internal combustion engine is a machine that as regards fuel economy has only one revolution speed at which the maximum of work can be performed with least amount of fuel. This he thought pointed to electricity being necessary as the link between the gas engine and propellers.

Mr. Durtnall thinks that in the large internal combustion engines of the future the exact automatic control of the valves, the moment of lift and time remaining open, etc., will be effected by electrical means.

An interesting method of firing the gases by a high resistance conductor which forms part of the secondary of an alternating transformer was shown. This gets over the difficulty of sparking plugs and the incandescing of the resistance bar can be timed very accurately.

An interesting gas producer to use either crude oil or coal as fuel was described and Mr. Durtnall pointed out that this would meet the objections raised to gas engines on board ship on account of particular coals being required. By using this new form of producer, oil could be used when coal was not available.

The author also showed the remarkable propeller invented by Vozacek, an Austrian engineer, the rights of which Mr. Durtnall now controls. This propeller rotates horizontally instead of vertically as an ordinary screw propeller does. It has two blades, which feather by means of a sun and planet motion so that the blade which is doing the work for the time being gives a direct thrust on the water. The propeller gives practically no wash, as was shown by the photographs, and being deep down in the water it is much more effective for a given blade area and number of revolutions than is the ordinary screw propeller.

One of the most extraordinary features of the propeller is that it acts perfectly as a rudder, and the simple movement of a steering wheel causes the pinion of the sun and planet motion to alter the relative position of the blades. The propeller can thus be made to move the boat backward of forward or push the stern to right or left.

DISCUSSION.

MR. E. KILBURN SCOTT, in opening the discussion, said that however much people might disagree with Mr. Durtnall regarding his revolutionary ideas on marine propulsion, etc., they could not but admire the way in which he stuck to his guns. He was brilliantly irrepressible. Certainly all this talk about using the internal combustion engine on

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board ship was favourable to electric propulsion, for being an engine that ran best at one definite speed electric transmission was necessary to link it up with propeller, and which must necessarily run at many speeds.

On warships the question of smoke was a most important one, and as anthracite was not always available, it was highly important to give consideration to a prime mover that worked without smoke whatever the fuel might be.

As far as gas engines are concerned, the keystone of the whole matter seems to lie with the gas producer. There are plenty of good engines and their theory and construction is thoroughly understood, but the gas producer is not half worked out. This was shown at Johannesburg, for although the engines would not give their power on account of the difference in barometric pressure, the main trouble was in the gas producers.

It is not easy to design a producer plant which shall make a suitable gas at all times whatever the quality of the coal may be, and he thought that the best solution would come when the large firms who have built up an enviable reputation in boiler making took over the design and manufacture of gas producers.

Mr. Durtnall's mention of a producer to make gas from crude oil was of great interest at the present time, because there would be very much less variation in oil found in various parts of the world than there is in the various coals which are now available. Of course, the simplest solution is to do away with the gas producer altogether, and use the crude oil direct in a Diesel type engine having a very high compression.

Some years ago he (Mr. Kilburn Scott) had been through a large number of iron and steel works and works making large internal combustion engines, to report upon the general position as it then was. He was struck with the fact that engines of 1,000 h.p. or more, working on blast furnace and coke oven gases worked as easily, and with as little attention as large steam engines. Of all the types of gas engine that he saw he liked the Oechlhauser the least, partly because it was too much spread out, and the Korting two-cycle type, with separate compressor the best. It is of interest to note that 2,000 h.p. engines of this type are being put down by Messrs. Mather & Platt for driving Messrs. Newton, Chambers & Company's Collieries and works near Sheffield.

Regarding the interesting horizontal propeller, with feathering blades, this was not only another step forward in propeller design, but is also pointed in the direction of electric propulsion. As the propeller spindles were vertical they must of necessity be driven by vertical type electric motors attached to upper ends of the shafts.

Mr. Kilburn Scott said he thought the Vozacek propeller would be excellent for canal boats, because lying deep in the water and giving practically no wash there would be less breaking down of the banks. It was the constant repairing of canal banks through the wash of the ordinary screw propellers that caused our canals to be so expensive and the traffic on them to be so slow.

Mr. Benyon pointed out that in the new propeller the blade area could be easily adjusted to any amount, the blades were simply flat plates, easily removable, and the feathering was perfect. Water was prevented from getting into the gear box by keeping the grease under pressure.

FINANCIAL NOTES.

British Columbia Electric Railway.—The directors of the British Columbia Electric Railway Company, Ltd., have declared a dividend at the rate of 8% per annum on the Deferred Ordinary stock in respect of the half-year to June 30.

* * *

Manx Electric Railway.—The directors of the Manx Electric Railway Company, Ltd., announce a dividend of 2¾% (2s. 9d. per share) on the Preference shares for the half-year, making 5½% for the year, carrying £236 forward.

The Synchronome Company inform us that in addition to their diploma of honour gained at Brussels, their system of electric clocks was used extensively in the Centenary Exhibition at Buenos Aires, and was awarded a gold medal.

THE ELECTRIC VEHICLE.

Recent Developments of the Lead-Sulphuric-acid Battery.

In a recent number of the Electrical Engineer, one of our contributors ("The Electric Vehicle," page 542) commenting on a letter from Mr. A. Hugh Seabrook, of the Borough of St. Marylebone Electric Supply, dealt with the question of English apathy with regard to this ideal form of locomotion, and gave some illustrations of the successful methods adopted in the United States with the object of popularising the electric car, both for pleasure and for commerce. In the succeeding issue Mr. Seabrook outlined briefly a scheme which he was proposing to put before his Committee in which the builders of electric vehicles in this country, the makers of storage batteries, and Marylebone Electric Supply were to combine to make a joint demonstration of the unique advantages of this form of propulsion, and he put forward the very wise suggestion that no electric supply undertaking ought to use anything but electric vehicles for their own special purposes. Of this excellent scheme we hope to have something further to say in a further issue; but meanwhile we learn from other correspondents that it is still the question of selecting an effective and economical battery which blocks the way.

At the recent meeting in New York of the National Electric Vehicle Association, an important paper on the electric vehicle battery was read by Mr. Bruce Ford, of which the text has now reached us. In the course of this paper, eliminating to a large extent as non-proven, the results of recent experiments with the nickel-iron-potash batteries, Mr. Ford makes it clear that he still pins his own faith to the lead-sulphuric-acid battery, the oldest commercial form of storage battery which this year celebrates its jubilee; but he points out that although the principles involved in this battery are the same as when it was first brought out in 1860, the battery as it exists to-day is the product of 50 years of continuous experiment. He claims, with justice, that the lead-sulphuric-acid battery has characteristics of high and uniform individual cell voltage on discharge combined with low internal resistance and high watt-hour efficiency which render this type of cell peculiarly adapted to the needs of electric vehicle propulsion where high currents are required for acceleration, hill climbing and bursts of speed, and urges that although the nickel-alkali-iron battery has a high capacity per unit of weight which makes it attractive where an abnormal amount of mileage is required per charge, it is new in commercial operation, and that no definite commercial figures have been obtained as yet to substantiate its claims, while high internal resistance and high initial cost are among its disadvantages.

On the other hand, he claims for the present standard type of lead cell, that the capacity per pound can be varied within certain limits by furnishing plates of different thicknesses. A thicker plate has a longer life in number of cycles of charge and discharge than a thin plate, but its capacity per pound on each discharge is not so great. The makers of the "Exide" battery have, he claims, developed commercially several thicknesses of which three will be described as being representative. The standard Exide battery has a positive 7-32 in. thick and gives a capacity initially of about 8 1-3 watt-hours per pound of complete cell at its 5 hour discharge rate, and this capacity will increase to about 10½ watt-hours in service. The "Hycap Exide" has a positive plate 3–16 in. thick, will give initially about 9¼ watt-hours per pound and will work up in service to about 12 watt-hours per pound of complete cell at the 5 hour rate of discharge. The thin plate battery has a positive 9-64 in. thick, will give initially about 10 watt-hours per pound, and will work up in service to about 13¼ watt-hours per pound of complete cell at the 5 hour rate of discharge, and he states that experience has demonstrated that with a given weight of battery where about the same percentage of the full capacity of the battery can be utilised on each discharge, the life in miles of the thin plate batteries is about the same as that of batteries equipped with thicker plates; that is to say, the extra mileage obtainable on each discharge practically compensates for the reduced

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number of discharges obtainable during the life of the batteries having the thinner plates.

Mr. Ford also claims that the test of actual experiment has shown that the lead battery is capable of considerable further development to produce higher capacity per unit of weight and also to produce plates of considerably longer life. In both the lead and the nickel types of batteries the action which governs the life is largely mechanical. In the respective processes of charging and discharging the battery, the active material of the positive pole plates becomes alternately oxidized and deoxidized. This alternate action causes a molecular disturbance which would eventually cause the active material to lose its coherence unless artificially maintained. In the lead battery it has generally been the practice to permit the active material to become gradually disintegrated and washed out from the surface, and to allow a reserve in the quantity of active material sufficient to produce a commercially satisfactory life. To the carrying around of this reserve active material in the lead battery is largely due to its greater weight per unit of capacity than that of the alkali battery whose active material is maintained mechanically to restrict its molecular disintegration.

The great difficulty with regard to the lead battery has, of course, been this rapid disintegration. It is claimed that the problem of preventing this washing away of the lead active material was solved some years ago by a French electrician, who devised a means of holding the active material in its place, and thereby prolonging the life of the plate with effective capacity for an almost indefinite period. Until recently, however, the method of achieving this end has been too complicated and expensive to make its commercial exploitation possible; but the Electric Storage Battery Company, of New York, after a series of experiments extending over three years, has now, says Mr. Ford, been unable to make a battery which will give initially in the neighbourhood of 9½ watt-hours per pound, increasing in use to somewhat over 13, with a life of from two to three times that of the standard lead battery, while during its life the necessity for cleaning the battery of sediment will be eliminated. In the course of the years of experimenting with this battery various means of still further increasing the capacity per unit of weight of the lead cell have been opened up so that a wonderful future, says Mr. Ford, may be predicted, not only for the new battery, but for the lead battery as a whole, of which this new battery is only one form.

In intimate connection with the subject of Mr. Bruce Ford's paper was an address delivered at the same meeting on the practical care of lead batteries for vehicles which was presented by Mr. S. C. Harris, of the New York Edison Company. Mr. Harris pointed out that the construction of the battery tray was an important matter if the best results were to be assured. For sectional batteries, he said, all that was required was that the tray should be made of wood of sufficient strength and of a size convenient for handling, but for single-tray batteries it was necessary to use iron. There are two ways to construct these trays; one in which the iron is used to brace the heavy wooden parts and one in which the tray is made completely of iron and light wood packing is used between the cells and the tray. In the sectional batteries the cells are placed in short rows; the voltage between consecutive rows varies with the size of battery and the number of trays, but is much less than in single-tray batteries. In single-tray batteries the arrangement of cells varies with the shape of the tray, but the arrangement should be such that the voltage between rows will be a minimum so as to prevent as much as possible the burning of jars if the trays and packing become acid-soaked, or if any foreign material lodges on top of the cells and becomes a good conductor through spraying or slopping of the electrolyte. The space allowed in the tray for the cells should be enough to permit at least ¼ in. between rows. The packing between the rows should be paraffined wood and should not come within 1 in. of the tops of the cells, while the packing should be tight enough to prevent any movement of the jars.

In assembling a cell the jar should be just large enough to receive the element, which should fit so that there can be no movement of the element in the jar. The wooden separators between the plates of the element should be thick enough to prevent any movement of the plates, and should be sufficiently wide to protect the edges of the plates from any material that may lodge between and short-circuit them, but the spacing between plates should be wide enough to allow sufficient acid for a complete discharge of the plate. The surfaces of the positive plate should be protected by perforated hard-rubber sheets, and the smooth side of the wooden separator should be placed against the negative plate. Strips of wood or hard rubber should be placed across the tops of the separators and securely fastened to prevent them from being misplaced. The separators should extend above the top of the plates. The pillar strap should be used and burned low to allow considerable space between the top of the cover and the top of the jar for the slopping of acid where cells are not sealed. With a battery constructed in this way, Mr. Harris advocates the following method of operation: Fill the cells with electrolyte of 1,200 specific gravity and pass a charging current through them at a rate of 1 amp. per positive plate for the M. V. size. If it is desired to complete the formation quickly a higher rate can be used if care is taken to prevent the temperature from rising beyond 100 deg. Fahr. This forming charge should be continued until the specific gravity of the electrolyte has reached its maximum and has continued at its maximum of 10 hours. One cell in the battery should be used as a pilot cell on which readings are taken at regular intervals near the end of the formation. This pilot cell should have its electrolyte kept at a constant level by adding a small amount of water at frequent intervals to make up for the loss by evaporation, otherwise the readings of specific gravity will not be comparable. The specific gravity readings should also be corrected for temperature. After the forming charge has been completed one or two discharges are taken to determine the capacity. If full capacity is not obtained it is usually due to the excessive hardness of the positive plates, in which case considerable discharging and overcharging are necessary if full capacity is desired before putting the battery in service. After the battery is put into service the following points should be carefully considered: proper charging; no over-discharging; filling cells with water of approved quality, and examining battery for leaking jars; keeping the tops of the cells free from dirt or any substance that will contaminate the electrolyte, and inspection of the battery for determining the state of charge of the individual cells. Care should be used to avoid putting more water in each cell than is required to cover the plates about ½ in. This advice should be closely followed, as it has been found in many instances that excessive slopping has been due to over-filling with the result that the wooden trays and packing become soaked with acid, and, therefore, good conductors, causing burning of jars. The cleaning of the tops of the cells is very important, as the dust from the street and material that is hauled in the vehicle is sometimes found in considerable quantity on the top of the battery, which, becoming saturated with acid, is another cause of burning jars. The battery compartment of the vehicle should be arranged to prevent this collection of dirt as much as possible.

CATALOGUES AND PRICE LISTS.

The following trade publications have been received:

The Switchgear Company, Ltd. (J. G. Statter & Company): (1) Magnetic Blow-out Fuses for D.C. (2) Insulated Box Spanners. (3) Magnetic Blow-out Circuit Breakers. (4) Model "E" Circuit Breakers, A.C. and D.C. (5) Switch Fuses. (6) Standard Knife Pattern Main Switches. (7) The Statter Patent Time Lag. (8) Model "V" Oil Switches. (9) Model "W" Circuit Breakers (totally enclosed, break under oil). (10) Mild Magnetic Blow-out Breakers, Model K. (11) Magnetic Blow-out Breakers, Model B, Minor. (12) Star-Delta Starting Switches. All these descriptive lists are illustrated.

Sun Electrical Company, Ltd.: (1) "Perfect" Shade Ring Remover, and Self-adjusting Nipple for Metal Filament Lamps. (2) "Sun" Sign Flashers.

Crompton & Company: Continuous Current Dynamos, Open Type.

General Electric Company, Ltd.: (1) "Witton" Primary Cells. (2) A Clean Sweep. The Electric Kleenall.

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COMMERCIAL TRAINING.

To those who have studied impartially the general trend of international commerce there can be no room for doubt that what our engineers stand most in need of is business training. Mr. Kilburn Scott discusses in another part of this issue his experience with young men in large works being trained as engineers, and gives some very interesting particulars of his system of teaching the art of taking out quantities and estimating. It is clear that we must, as early as possible, bring students face to face with practical facts of the commercial side. It is not everything to have mastered the theory of engineering, or even to have gained efficiency in designing and manufacture. More than this is required if we are, not only to maintain our lead, but make further progress in commercial expansion. Nobody calls in doubt the ability of British manufacturers to turn out first-class articles. But there is too often a regretable want of flexibility in our business methods, as well as an unwise delay in taking up new ideas. This is largely due to deficiency in commercial training, a deficiency which places the engineer at a serious disadvantage when competition has to be faced, or the possibilities of new combinations have to be upraised. Take a case in point: An inventor having secured an opportunity for putting a new system to a practical test, drew up specifications for a certain class of prime-mover and then interviewed a number of British manufacturers. They were, apparently, rather startled at the novelty of the suggestion, and although assured of satisfactory financial terms, hesitated to take up the job, professing to be very busy. Several of these firms where, according to their own showing busy with unprofitable work, but they took from six to eight weeks to send in tenders. Meanwhile the inventor had grown tired and taken a trip across to France. There he was met by the managing director of a big engineering firm and conveyed to

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the works. He explained his requirements, assistants were called in to take notes and examine drawings, and within ten days of the inventor's return to England he received a complete tender from the French firm, and this tender was quite 25% under the British prices, while the time for delivery was far more satisfactory. Now, the inventor was obliged to advise his principals to go abroad for one of the chief items of the outfit. Can there be any doubt that the difference operating in this actual case was the difference of commercial training and business organisation in the two countries? The British chiefs were distrustful of anything new, there subordinates lacked the power to grasp the potentialities of the business offered to them; hence an inflated estimate. The Frenchman was quick to see that the business offered to him might well develop into big things, and he called in his engineers to deal with the case at once from a technical and a commercial standpoint; hence the moderate estimate and unhesitating undertaking as to time of delivery. There is, unfortunately, too much of this kind of thing going on. Happily British work is unsurpassed, and when we do wake up we forge ahead. But it does not do to make mistakes such as the one quoted above, or to gain the reputation of being impracticable. Business once lost is not quickly recovered. It is to guard against such mistakes that the cry is arising, ever more persistent, of necessity to remodel our system of education.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "THE EDITOR, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

COMMUTATOR GRINDER.

SIR,—I should be much obliged if you would kindly insert the following in the next issue of THE ELECTRICAL ENGINEER:—

Would any of your readers kindly inform me who are the makers of the Phillips Commutator Grinder, what is the average price of this machine, and can it be adapted to any make of dynamo or motor, and if so, what are the limiting sizes of commutator one instrument can grind.

Sudan, November 10. "SUDAN."

[The makers are Phillips' Commutator Grinder Company, Ltd., Hart-street, New Oxford-street, W.C.

We are always glad to place our readers, especially Overseas readers, in communication with manufacturers of any type of machinery or appliances required.—ED.]

PUBLIC STREET LIGHTING.

Sir,—Recently various articles have appeared in the Press concerning public street lighting by gas and electricity, with particular reference to some recent contracts in London for street lighting by means of gas.

Whilst, of course, the question is largely one which concerns local authorities under different circumstances, the recent articles referred to have led to a considerable amount of controversy in many boroughs as to which is the most efficient method, and consequent upon this, various questions have been asked in public concerning the relative costs and the efficiency of the lighting obtained from the two sources.

Although the Press have given considerable publicity to a recent contract, it is only fair to consider the existing circumstances under which the two supply authorities are supplying street lighting, and in this connection the information published in the "Islington Gazette," which is marked on the copy enclosed herewith, proves conclusively that, under the present conditions of the lighting contracts in this district, electricity is, light for light, five times cheaper than gas. In this particular case the Council have further decided to put up 16 additional electric arc lamps of high candle-power which will displace 40 gas lamps and result in a saving of £34 10s. per annum to the ratepayers of Islington.

While I recognise that the pressure on your publication at the present time is very great, I trust you will find room to give this matter consideration.

Yours, etc., "ELECTRICIAN."

December 6, 1910.

The report referred to is printed below:—

ISLINGTON BOROUGH COUNCIL.

Ald. Vorley delivered a crushing reply to Councillor Byers (who, by the way, was not present when his question was answered). His figures, which are appended, show that light for light, candle-power for candle-power, electricity is five times cheaper than gas. Ald. Vorley read the questions and replies given at the last meeting of the Council:—(1) The total amount spent by the borough per annum for the public lighting of the streets, including the supply of gas, electricity, and maintenance —£28,337. (2) The number of miles of streets lit by gas, and the cost of the gas and the maintenance of the lamps—about 100 miles; cost, £13,112. (3) The number of miles of streets lit by electricity, the cost of electricity, and the maintenance of the lamps—24 miles; cost, £15,225.

Ald. Vorley then replied to the questions raised by Councillor Byers as follows:—

What is the candle-power of the arc and flame lamp respectively?—Arc lamp, 800 candle-power; flame arc lamp, 3,500 candle-power.

What is the candle-power of the gas lamps?—Forty-five candle-power.

(He pointed out that these figures were the average of an exhaustive number of tests taken with the same instruments under similar conditions, and are well within the recognised authoritative figures.)

What is the total candle-power of the electric lamps in the streets referred to?—1,167,936, or 48,664 candles per mile.

What is the total candle-power of the gas lamps in the streets referred to?—190,044, or 1,900 candles per mile.

Referring to the question asked at the last Council meeting, Ald. Vorley said the cost of gas per mile was £131.1; and electricity, £634.4.

Electricity costs 4·8 times as much as gas per mile.

Electricity gives 24 times as much light as gas per mile.

Under the present conditions of lighting, electricity, light for light, is five times cheaper than gas.

Ald. Vorley went on to say that the "Gas World," commenting on the replies given at the last Council meeting, inferred that gas was cheaper than electricity. In Islington, reiterated the Alderman, electricity for public lighting was five times cheaper than gas—candle-power for candle-power. There was, he added, no intention on the part of the Lighting Committee of the borough to go back to gas, and he hoped that the "Gas World" would take note of his answers.

LONDON'S ELECTRICITY.

Joint Conference of Supply Authorities.

The Joint Conference of London Electric Supply Authorities held a meeting at Cannon-street Hotel on Thursday, which was well attended. Mr. Ernest Debenham (Mayor of St. Marylebone) occupied the chair in the absence, through illness, of Mr. W. F. Fladgate. An interim report of the executive committee of the conference was submitted, approved and adopted. This interim report dealt with the extensive work which has been carried out during the past year by the executive committee, assisted by the joint engineer's committee, in setting out the bases of a linking-up scheme under the London Electric Supply Act, 1908. Reference was made to the valuable information, of a confidential character, which had been collated by the joint engineers' committee, bearing on the question of the supply of London, and upon which the engineers are still engaged. The executive committee were unanimously re-appointed. A resolution was passed expressing appreciation of the work of the Electric Supply Publicity Committee, and it was unanimously decided that the members of the conference should subscribe a substantial amount to the funds of the publicity committee on a revenue basis, for the purpose of their developing a still more vigorous advertising programme.

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Electrical Progress at Home & Abroad.

Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

The Newcastle branch of the Association of Mining Electrical Engineers decided, for the benefit of the members living in the southern part of the county of Durham, to hold a meeting in Durham city, and on Saturday last this was carried into effect without benefiting the meeting so far as attendance was concerned. Apart from this, however, the meeting was important as it discussed the examinations to be instituted by the Association. Mr. Clothier especially urged that the examinations should be commenced as quickly as possible, and elicited a statement from Dr. Thornton, the chairman, that in January next it was probable that the first examination would be held. The question of the value of an oral examination in determining the actual experience in practice as opposed to theory was discussed, and the opinion seemed to be that the more satisfactory method was to insist on guarantees of two years previous practical mining electrical experience. A pleasing experience of the meeting was that, in response to an enquiry from Dr. Thornton as to how many members there present would be prepared to sit for an examination equal to that of the New South Wales colliery electrical test, if this were held in the middle of January, 60% of the members present signified their willingness. If half the members of the Newcastle section sat, there would be 50 candidates for the first examination.

The Inspection and Repair of Plant.

The meeting then discussed a paper on the Inspection and Repair of Electrical Plant Underground, presented by Mr. R. R. Smith, of the Staffordshire branch. This consists of an elaborate analysis of the defects of electrical plant in mines, and methods of repair. Dr. Thornton regarded the list as a standard list to which additions should be made by members desiring to do so, and possibly to publish the same as a small handbook for the use of colliery engineers and electricians, dealing with defects, inspections and repairs. An interesting point which was raised in the discussion was the apparently trivial one of utilising locking washers for nuts on electrical switchboards and machinery. The use of lock-nuts was condemned as these, though binding together, apparently work back and leave washer and lug, for example, loose, producing bad contact. Some experiences of trouble due to the absence of locking washers were given, and it was stated that manufacturers exhibit a strange reluctance to use brass spring washers. Another point raised was the proper insulation resistance to be insisted upon, one member giving as his practice one megohm for each 1,000 volts working pressure, while another had operated a 6,000 volt circuit for two years with only a-4 megohm insulation resistance.

Electricity and Business Enterprise.

The business proprietors of Newcastle—at anyrate those situated in the Central Arcade—are exhibiting much enterprise at present in combining in order to establish a colossal Christmas display and decoration of their arcade for the Christmas month. This has been opened during the past week by the Sheriff of Newcastle. There are electrically illuminated Christmas trees, festoons of evergreen interspersed with electric lamps, artistic decorations, a string band in the balcony, and a service of tea and coffee on the balcony from a café in the arcade. The shops themselves have special lighting effects, and the entrance to the arcade is illuminated by flame arc lamps, the effect being continued by a double line of arcs distributed along the promenade. These lamps have been kindly lent to the promotors of the enterprise by the Newcastle-upon-Tyne Electric Supply Company, Ltd. In addition to these, over 300 incandescent electric lamps have been used in the festoons, the whole installation being made by Messrs. Robson & Coleman, of Newcastle. The enterprise has already proved a tremendous "draw" and shows the advertising value of electricity.

Lord Furness and the Lock-Out.

A phase of the lock-out which puts an entirely new light on the probabilities of a long-continued fight has been produced by Lord Furness's declaration that unless the Employers' Federation accepts and agrees to the solution which, it is understood, Mr. Askwith is going to put forward, he (Lord Furness) will exert his influence to bring the lock-out to an end. He is in every probability quite able to do this, because of the important positions he holds in the leading firms of this area. Frankly speaking, a large section of the engineering public not directly interested in the fight would be very glad if he did, as the amount of damage inflicted upon the general business interests of this area by the dourness of employers and employed is incalculable.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

There is every reason to believe that the year's returns of the Birmingham Corporation Electricity Department will show a substantial increase in consumption, both for lighting and for power. Latterly, the new connections for power have been chiefly for small motors, the use of which is growing in more than an arithmetical ratio. Birmingham is notably an industrial centre in which the small shop system has survived longer than in most other manufacturing towns, and, in spite of the growing tendency to amalgamation and centralisation, this state of things will probably last for a long time to come. It is in small factories and workshops that the electrical motor is rapidly supplanting hand and foot power, but it is also making inroads into places where gas engines of smaller and larger size have hitherto been employed. With the coming extension of the city, this opens out large possibilities for the department, inasmuch as there are not only in the suburbs several extensive factories waiting to take the current, but also a large number of firms of the "small master" class who are likely to follow the example of their compeers within the present city boundary.

A Successful Exhibition.

The exhibition of power appliances at the Corporation electricity offices in Dale End has proved a great attraction, and already many new installations may be counted upon as having been secured by the opportunities given to manufacturers to study the practical application of electricity in various engineering and other industrial operations. The Cookery and General Domestic Exhibition, which was to have followed, has been postponed until the spring, but the showroom already has a fairly representative selection of electrical domestic appliances. In the contemplated exhibition, a series of demonstrations of cooking, etc., will be arranged. In the meantime some of the most interesting illustrations of the use of electricity for manufacturing purposes will be retained and exhibited in working order.

Motor-Driven Blowers.

An illustration of the interest which has been shown in the power exhibition and demonstration was afforded at a recent meeting of the Birmingham Branch of the

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British Foundrymen's Association, when reference was made to the blowing appliances shown at Dale End. The occasion was a paper contributed by Messrs. A. D. Ellis and C. E. Johnson, of Thwaites Bros., Ltd., on "Roots' Blowers." In dealing with motor-driven blowers, the authors said that the slow-speed motor coupled direct to the blower was preferable to the high-speed motor operating through the reducing gear, because although the first cost was greater, the increased efficiency and the economy in current appertaining to the former made it cheaper in the long run. Air might be admitted to the blower either at the top or at the bottom, and discharged either from the top or bottom; but the usual practice of admitting at the top and discharging at the bottom, although not always practicable, yielded the higher efficiency. The authors gave the following, among other, formulæ relating to the subject: Formula for obtaining the brake-horse-power required to driver blowers $\frac{C \times W.C}{4,400}$ = cubic feet of free air per minute. W = pressure of air in inches of water. Particular interest was shown in a reference made to the blower on exhibition at the Electricity Department, which illustrates on the control principle adopted by Thwaites Bros. for the automatic regulation in speed of electric motors when driving blowers and other machines subjected to varying demands and yet required to maintain a uniform pressure. In this regulator, the current is controlled by rheostat in the fields of the motor, and when any variation occurs to whatever cause, it may be due, the pressure rapidly returns to the normal for which the machine has been set.

Electricity and its Rivals in Mining.

An important discussion is anticipated at the next meeting of the South Staffordshire and Warwickshire Institute of Mining Engineers on "The Comparative Merits of Gas Engines and Electrical Motors for Colliery Purposes, both Pumping and Winding." At the meeting held this week, the discussion was resumed upon a paper contributed in July by Mr. Thomas Henry Baker, M.I.C.E., upon "The Sinking and Equipment of the Littleton Colliery," an enterprise which has attracted great attention in the Midland on account of the difficulties met within sinking and the many novel features in the power equipment. On Monday, the discussion opened with the reading of a communication by Mr. John Burns, of Willans & Robinson, Rugby, in which the arrangement of the steam and gas-driven plant was strongly criticised. For instance, Mr. Burns suggested that a considerable amount of steam was being used not to the best advantage in the fan engines and in the steam-driven electric generators. It appeared to him that by utilising this steam from the winding engines and fan engines, all the required electrical power could be obtained, while these were running, while the amount of live steam required for the generator when these engines were not running could be considerably reduced by suitable arrangements of the electrical output.

A Battle-Royal Arranged.

In the discussion that followed, there was much talk as to the relative advantages of electrically driven turbines and other methods of raising water, and two or three speakers suggested that representatives of firms purveying rival plant might be invited to "do battle" before the Institute. The secretary was able to inform the members that something of the kind had been arranged, as on February 6, Mr. John Burns, of Willans & Robinson, and Mr. McKinstry, of the Westinghouse Company, who put in the gas engines at Littleton, were to come and fight the battle in that room. It was understood that Mr. Burns was to take the side of steam turbines, but, no doubt, the question of electrical generation and utilisation will come up.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

The following table has been compiled by Von Mollendorf as the result of his researches into the comparative value of different weather resisting metals and alloys as conductors.

Metal	Tensile strength: kg per sq. cm.	Weight in kg per cm. length and sq. cm length (divided by 10,000.)	Elasticity modulus kg. per sq. cm. (multiplied by one million)	Heat expansion co-efficient per deg. C. (divided by one million)	Resistance (ohms per km. at 15 deg. C.)
Steel ..	8,000	78	2·1	12	7·0
Iron ..	4,000	75	1·9	12	5·0
Best Bronze	6,300	87	1·3	17	3·2
German patent office bronze ..	5,100	89	1·3	17	2·9
Hard copper	4,500	89	1·3	17	2·9
Aluminium	1,800	27	0·65	23	3·5
Spree aluminium ..	3,000	28	0·7	22	3·5

Spree aluminium is a special aluminium made by the A.E.G. Von Mollendorf arrives at the following conclusions:—

1. Light metals are so far cheaper than copper that even where the sag of the wire cannot be allowed greater the saving in cost of wire usually more than pays for the extra expense for masts, insulators, etc.

2. For large spans Spree aluminium is to be recommended. It is equal in strength to hard copper and the best bronze and is cheaper than hard copper so long as crude aluminium is not more than 50 per cent. more expensive than crude copper.

3. Qualitatively considered, aluminium is only surpassed by the best bronze.

New Rhine Power Station.

The Grand Duchy of Baden and the Aergau canton are being approached with the view to the erection of a big power house at Schworstadt on the Rhine. A syndicate has been formed, consisting of the A.G. Motor, of Baden, the Mittelsassiche Elektrizitatswerk Markkich, Kappenmuhle A.G., and Brown, Boverie & Company, of Mannheim. The power is derived from the Rhine between Sackingen and the Elektrizitatswerke Rheinfelden, and a movable weir will dam the river at Schworstadt, whence the water will be taken to the power house on the right bank by a channel five furlongs in length. The available head of water averages 10 ft., and the h.p. obtainable can be put at 50,000 for nine months in the year. During the other three —the winter months—it will be considerably less. The concessionees propose to supply electric energy to the Grand Duchy and also to Alsace, especially Middle Alsace.

Sag of Open Air Wires.

Every electrical engineer knows that the permissible sag between masts of open air conductors exposed to great changes of weather and fluctuations of temperature, and the weight of ice and snow is a matter of great importance, and is fully dealt with in the "E. T. Z.," commencing with the issue of November 17.

Company Notices.

The report of the Berlin Elektrizitats Werke for 1909-10 shows a steadily growing prosperity. The dividend is still 11 per cent.

The A.E.G. fur Alektrixitatsanlagen increased its net profits from 538,629 marks in 1908-9 to 6,022,289 on 1909-10, and the dividend has been raised from 6 per cent. to 7 per cent. on the capital of seven million marks.

Korting's Elektrizitatswerke, Berlin, made a gross profit for 1909-10 of 1,033,946 (886,646) marks, and a net profit of 240,133 (199,399) marks. Seven per cent. will be paid on the capital of three million marks, as against 6½ per cent. for 1908-9 and 9,330 (12,262) marks will be carried over.

The Berliner Elektrizitatswerke has declared a dividend of 4½ per cent. on the preference and 11 per cent. on the ordinary shares.

The Siemens Schuckert Werke are about to increase their capital probably by no less a sum than 20 million marks. The fresh cash will be expended in increasing the premises here and in Nurnberg. In connection with this fresh issue it is reported that the Elektrizitats Gesellschaft Schuckert proposes to increase its own capital by 10 millions.

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Electric Machinery Control.

One of the chief dangers in factories of every kind is that of workpeople becoming entangled with moving machinery, the result often being death or serious injury. The accident generally happens at a place far removed from the controls of the running, and even if the machinery can be thrown out of gear at once its momentum helps to prolong its motion. Herr Krohn, writing in the "Verkehrstechnische Woche," describes a highly valuable safety apparatus which can be attached to all electrically-driven machinery. Knobs are provided at many easily accessible places by pressing which the whole or any part of the machinery can be stopped in from three to seven seconds. The pressing of the button not only switches the current off the motor, but switches it on to a powerful magnetic brake. When it is desired to resume running the switching of the current from the brake turns it into the armature of the motor. The apparatus is made by the Felten & Guilleaume, Lahmeyer Werke in Frankfort.

Electric Cranes.

For cranes which employ great power or require frequent and accurate reversals, the Siemens Schuckertwerke employ a reversing gear worked by a continuous current on the Leonard system, where the armature of the motor receives its current not direct from the main but through a regulating continuous current dynamo running at high speed so as to be as small as possible. As the speed of the motor is regulated mainly by the tension of the current supplied to its armature the direction of rate of the revolution of the motor can be controlled by an ordinary reversing lever. The regulating dynamo is driven by a small motor on the same axle.

Electric Transport.

An electric apparatus for unloading coal cargoes and transporting the coal from the quay to the furnaces has been built by Shencks of Darmstadt for the Mulhausen Elektrizitats Werke. The self-acting grabs are worked by a 30 h.p. electric motor and raise 30 tons an hour. The travelling crane runs on overhead rails, 40 feet apart and 35 feet from the ground, and is actuated by a 15 h.p. motor. The travel is 130 yards from quay to works. The coal is weighed between grab and crane in an automatic weighing machine, which will weigh 11 tons at a time with a maximum error of 20 lbs., and also cast up the totals.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

In the technical world generally, and in particular in the electrical world, exceptional interest has been aroused by the appeal for the creation of a department of technical research which has been put forward in his annual report by President Schurman, of Cornell University. The world of the future is on the knees of the scientific investigator, himself in the last and every event the arbiter of human progress. In our Universities at the present moment, perhaps also in those of the Old World, there is a slackness, an absence of incentive, a satisfied-with-things-as-they-are kind of atmosphere, which, whatever else it is doing, is not making for the advancement of those arts and sciences which is demanded by the complex requirements of modern civilisation. President Schurman condemns in terms of almost brutal frankness the existing conditions. He talks strongly of the present degradation of undergraduate education, and urges the folly, or worse, of permitting men who have no intellectual tastes or interests, "provided they can find a sufficient number of easy courses or easy-going teachers," to spend four years without much immediate profit to their minds, and "with ultimate serious damage to their character, in consequence of the formation of habits of idleness, listlessness, and perhaps deception, sham, and grafting." These are strong words, but the President of Cornell is not alone in thinking the thoughts which have evoked his indictment. President Lowell, of Harvard, has expressed much the same thing in gentler words, and so has the Alumni Committee of Yale. All concur in the advocacy of such an extension of University work, especially in the direction of a department of research, as will give an impetus to the student to seek fresh fields of effort when he has graduated. We have made marvellous progress in many departments of intellectual and scientific activity in this country, and especially in the matter of electricity; but where might we not have been in this last-named field, had we established half a generation ago an electrical engineering laboratory purely for purposes of investigation and research? Some of our most important discoveries in this sphere, which within the past few years have been made almost fortuitously, might have been elucidated by specialised research ten years earlier to the great benefit of the whole civilised world. President Schurman thinks it would cost twenty million dollars to endow such a department. The interest on such a sum would be a million dollars a year, and there is a general concensus of expert opinion that to the nation and the world at large it would be worth a far higher expenditure if it could successfully be brought into being. And there is a healthy prospect of a beginning being made in the not remote future. "We have plenty of multi-millionaires," says President Schurman; "here is their opportunity to slip in and promote, as no movement has ever done before, the higher intellectual life and civilisation of the nation. The advantage of universal higher education may be retained for all who are qualified to enjoy it, without sacrificing those youth of superior or extraordinary endowments, among whom will always be found the men who advance civilisation and move the world forward in the course of progress. These glorious 'sports of nature' have in their unique endowments the possibility of higher things for civilisation provided only that it is developed by favourable environments. A seminary for the aristocracy of talent would be the highest and noblest institution in the world. No other service to the democracy could compare with this, for to form the mind and character of one man of marked talent, not to say genius, would be worth more to the community which he would serve than the routine training of hundreds of undergraduates. Let the superior student be regarded as a supreme object; let the men of talent be segregated and instructed by themselves; for what is better worth while in the world than provision for the instruction of the world's best minds and the moderate satisfaction of the bodily needs, that they may pursue their studies not only undisturbed, but under the most favourable and stimulating conditions?"

E.M.F. Waves and Incandescent Lamps.

Some remarkable conclusions have emerged from the experiments recently conducted by Professor Charles Kinsloe at the Engineering Experiment Station of the Pennsylvania State College into the effects of the form of alternating E.M.F. waves upon the life and efficiency of plain carbon, graphitized carbon, tantalum, and tungsten lamps. It has hitherto been accepted that the candle-power, specific consumption, and life of incandescent lamps vary with the mean effective value of the electromotive force wave without relation to the maximum value, but Professor Kinsloe found that the lamps suffered a marked decrease in life and efficiency, when the E.M.F. wave was peaked rather than sinusoidal, the decrease varying from 25 to 50% when the wave reached a peak value of 12% higher than the maximum of the equivalent effective sine wave. Professor Kinsloe states that two groups of lamps, each group composed of a number of each of the four types mentioned, were operated until their filaments were broken. The first group was supplied with energy from a generator developing a pressure approximately sinusoidal and the second group was supplied by a pressure having the same effective value as the former, but having a maximum about 12% higher than the sine. At frequent intervals the power consumed by each lamp under test was measured, and at the same time each lamp was photometered, so that a record of the specific consumption of each lamp under both conditions through-

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out its life was obtained. The pure carbon lamps operated with a sine wave gave 17 c.p. at the start, 13 c.p. at 800 hours and 10·5 c.p. at 1,500 hours, consuming 3·25 watts per candle at the start 4·2 watts per candle at 800 hour and 4·9 watts per candle at 1,500 hours. With the peaked wave the same type of lamps gave 15·7 c.p. at the start and 11·3 c.p. at 800 hours, consuming 3·6 watts per candle at the start and 4·75 watts per candle at 800 hours. The carbon lamps on the sine wave continued in service for more than 1,500 hours, and it was not until nearly 1,000 hours had been reached that the candle-power had fallen by 20%. The lamps on the peaked wave burned out in about 800 hours, and before 500 hours the candle-power and efficiency had fallen to values not reached by the lamps of the first group until they had operated for over 1,000 hours. The candle-power and efficiency of the graphitized carbon lamps decreased by 20% after 800 hours on the sine wave and after a little less than 400 hours on the peaked wave. As was the case with the pure carbon lamps, the candle-power of the lamps on the sine wave was higher from the beginning and retained this advantage throughout the test period. Of all the lamps tested, Professor Kinsloe found that the tantalums were most seriously affected by the peaked wave, their life being reduced very nearly 50%. With the tungsten lamps the initial output of 51 c.p. with a sine wave diminished to 38 c.p. at 1,500 hours, and specific consumption increased from 1·26 watts per candle to 1·62 watts. With the peaked wave the candle-power varied from 48 at the start to 43 at 600 hours; specific consumption beginning at 1·32 watts per candle and reaching 1·47 watts at 600 hours. "All the tungsten lamps," says Professor Kinsloe, "regardless of wattage, showed a marked similarity in behaviour, the advantage of a sine wave over a peaked wave being very pronounced."

The Light of the Firefly.

For some weeks past an extremely interesting discussion on the phenomena of the light of the firefly has been in progress in the columns of the New York "Electrical World." Broadly speaking, it may be said that the general trend of the investigation so far as it has gone, is of a character to support the generally accepted theory that the light of the firefly is caused by the slow oxidation of a substance which the insect is continuously engaged in producing. There is a luminous tissue which can retain for a considerable period its luminosity when subjected to purely chemical oxidation so long as it is kept in the meantime out of actual contact with oxygen. With regard to this point Professor F. A. McDermott, of Washington, who has been investigating the phenomena in conjunction with Professor J. H. Kastle, of the University of Virginia, states that the luminous tissue dried over sulphuric acid in an atmosphere of hydrogen retains for over a year its power to glow when moistened with water in the presence of oxygen. If commercial hydrogen-peroxide be used in place of water, the light is more intense, and its spectrum is very limited, extending only from the orange to the yellow-green of the visible spectrum; and Professor McDermott cites the fact that Professor Trautz has found that in pyrogallol oxidised by strong hydrogen-peroxide in the presence of formaldehyde there is a substance which produces a spectrum which covers almost exactly the same spectral area as that of the firefly. The "World," in commenting on this part of Professor McDermott's communication, which it regards as an important step towards the practical production of chemical luminescence, observes that "if it should be found that this light is really unaccompanied by any material amount of other radiations, it would appear that there is a theoretical available method of producing a continuous spectrum over a very narrow range, a thing which is quite outside of previous experience. Of course, it might turn out that in the case of the firefly the radiations of longer wave length are utilised in doing physiological work in the organism to an extent which would practically suppress them as regards external effects. In this case the total efficiency of the operation might be really very moderate. It is therefore doubly important to examine the cases of luminescence which occur without the complication of having their seat in organic tissues," but in any event, the "World" thinks, "that from the chemical standpoint the firefly's secret does not belong in the region of the physiological unknowable, and that there is a fighting chance of its being discovered and put to some practical use." Returning for a moment to Professor McDermott's letter, it may be useful to note his declaration that all attempts to isolate and analyse the substance oxidized by living organisms having the power of producing light have so far ended in failure. The luminous organ of the firefly consists of two layers of material under the outer transparent chitin. The inner layer consists mainly of guanin (a compound similar to uric acid) and probably serves as a reflector; this guanin reflector appears to have been found also among the photogenic fish and cephalopods. The outer layer consists of a mass of cells, apparently nucleated and normally of a pale yellow colour. Both layers are penetrated by innumerable minute tracheæ, which unite in the interior of the insect to form larger passages and run together in the outer layer of yellow cells, forming a network somewhat resembling the finer veining of a leaf. It is practically certain that in life these passages are filled with air, and it seems probable that the photogenic process is accompanied by the evolution of carbon dioxide and the consumption of the oxygen of the air.

Interpoles in Synchronous Converters.

At the November meeting in New York of the American Institute of Electrical Engineers a noteworthy paper on interpoles in synchronous converters, contributed by Messrs. B. G. Lamme and F. Newbury, formed the subject of a very interesting discussion. The authors in their paper discuss the effects of interpole construction on commutation in direct current machines and point out that a synchronous converter differs considerably from a direct-current generator, because it is also at the same time an alternating-current motor. The magneto-motive force of the armature winding as a motor acts in one direction, while that as a generator acts in the opposite direction. These two magneto-motive forces, therefore, practically neutralise each other; the resultant or effective magneto-motive force in any case is not over one-fifth of that as a direct-current generator. Consequently commutation of a synchronous converter is not nearly as troublesome as in a direct-current generator. If interpoles are used on the converter they would be only 25 to 40% as large as on a direct-current generator. The pulsating resultant magneto-motive force in the converter would tend to cause trouble, but it is of relatively high frequency and, therefore, dumps itself out without any noticeable harmful effects in a well-designed machine. The magnetic leakage from interpoles is more troublesome. Shunting of the interpole current is needed in some instances, but a non-inductive shunt is not serviceable with sudden load fluctuations.

Interpoles and Overload Conditions.

Messrs. Lamme and Newbury then proceed in their paper to discuss overload conditions and point out that in the case of a converter the presence of interpoles may cause serious trouble owing to the overbalancing of their ampere turns, and, therefore, the conversion of the interpoles into paths for the excessive armature flux thus developed. A short circuit on the direct-current end, opening the circuit-breakers there, would not reduce the electro-motive force, since the converter would still be connected to the alternating-current supply. Hunting also would greatly complicate matters and make interpoles of little useful value, if not a positive detriment. The authors then take up the four most common types of converters, namely, 25-cycle 250 and 600-volt machines and 50-cycle 250 and 600-volt machines, considering in each case the features that limit the design and particularly the possibility of increased speed and effect of interpole construction. Their opinion is that the 600-volt machines offer the most promising field for the use of interpoles and that the 250-volt machines would probably not be improved in design. Summarising their conclusions, the advantages of interpoles with higher speeds would, they urge, be: Possible reduction in cost, less attention required in operation, and longer life of commutator and brushes.

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The disadvantages, however, would be: Possible increased trouble from "bucking" on sudden load changes or short circuits, possibly reduced efficiency, higher operating temperatures. If increased speed was not possible, the advantages would be diminished, the disadvantages increased. and refinement in design at greater original cost would seem to be the only result. In the course of the discussion reference was made to Mr. F. W. Young's device of placing a "dead" brush adjacent to the live one so as to obtain a somewhat higher E.M.F. at the heel of the latter. Another speaker urged that the greatest field of usefulness for interpoles on rotaries was on machines for voltages from 1,000 to 1,500, and also for 600-volt rotories in intermittent service where the load is liable to change from zero to as much as four times the rated load. This speaker's experience was that if the interpoles were properly designed no bucking or flashing will result even on continued heavy short circuits, and that a machine properly designed would not flash over with six or even eight times the normal load. A third speaker narrated the results of some experiments made with a 25-cycle, 1,200-volt rotary in which it was found that the addition of a narrow interpole with large air gap made it possible to secure four times the load from the rotary without sparking as was possible before the interpoles were added.

New Uses for the Telautograph.

A good many of the leading banks in this city have installed the Telautograph on their cashier's desks as a protection against losses. When a cheque is presented for payment and the cashier is in any doubt as to the customer's balance or identity, he simply takes the Telautograph stylus and quite unknown to the customer the desired query is silently and instantaneously conveyed to the book-keeping department, and just as silently and almost as instantaneously, the reply appears at the instrument. In Chicago the principal clubs have installed these instruments with the object of doing away with the confusion and delay attendant upon finding a member who may be wanted. This operation is usually performed by a page-boy who goes from room to room shouting the name of the member sought for. By means of the Telautograph the name is instantaneously and simultaneously communicated from the inquiry office to every room in the club, and the attendant in each room can see at once if the member sought is present.

Insulation of High Tension Lines.

Dealing with the question of mechanical and dielectric strains in insulators for high tension transmission lines the "Electrical World" observes that the relation between these mechanical and electrical strains has been realised sufficiently to cause the insertion of clauses in many insulator specifications requiring that the application of the test potential be made while the insulator is subjected to its rated mechanical stresses, just as if it were supporting a line-wire span. Good evidence of the fact that insulating material, such as porcelain, will break down electrically much more readily when under mechanical strain was afforded by the experience of a Western hydroelectric company which had great trouble with its high-tension entries where the transmission lines were brought through tubes at the centres of circular insulating discs. These tubes were fastened rigidly to the supporting discs, and at frequent intervals, whenever line conditions passed slightly beyond the normal, the tubes would be shattered with a loud report. Realising that with the construction used any movement of the wires in the wind outside caused strains in the insulator tubes, it was decided to mount the tubes loosely in the supporting discs so that they would be free to move slightly with the wires. After this slight change was made the entry-insulator trouble, which had become really serious, entirely disappeared.

OBITUARY.

Mr. Malcolm Sutherland, Burgh Electrical Engineer of Oban, died on the 29th ult., in his 47th year. Mr. Sutherland, after serving his time in a shipbuilding yard, gained his technical education in Lord Kelvin's laboratory at the Glasgow University. He joined the firm of Messrs. Muir, Mavor & Coulson, and was the first engineer in charge of a generating station for public supply in Glasgow. He superintended the running of the overhead mains in connection with the Glasgow supply at that time. Mr. Sutherland was later retained by the firm of Messrs. Denny & Company, of Dumbarton, and advised them with regard to the electric lighting and equipment of several large boats built in their yard. Proceeding to London, he became a partner in a firm specialising in the manufacture of small accumulators. Some years ago he returned to Scotland and worked as a mains superintendent with the Clyde Valley Power Company. Four years ago he was appointed Electrical Engineer to the Burgh of Oban. Mr. Sutherland's training and capability warranted his holding a much more important post than that at Oban, but he was attracted there for family reasons. He regularly attended the annual meetings of the Municipal Electrical Association, and although he did not take a prominent part in the proceedings, he made many friends and was much esteemed both as an engineer and as a man.

DIARY.

FRIDAY, DECEMBER 9.

NORTHAMPTON POLYTECHNIC INSTITUTE.—John-street, Clerkenwell, at 6.30. Annual Conversazione.

MONDAY, DECEMBER 12.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, at 8 p.m., C. R. Darling on "Industrial Pyrometry" (Cantor Lecture No. IV.).

INSTITUTION OF ELECTRICAL ENGINEERS (Newcastle Local Section).—Armstrong College, at 8 p.m. Adjourned meeting on "Electric Winders."

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Association).—At 8 p.m., a paper on "Requirements of Illumination and the Status of Gas Lighting," by Mr. J. C. Briggs, graduate, of Workington.

TUESDAY, DECEMBER 13.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Students' Section).—At the Manchester School of Technology, at 7.30 p.m., Mr. A. R. Stelling, on "Organisation and the Reduction of Manufacturing Costs."

INSTITUTION OF ELECTRICAL ENGINEERS (Yorkshire Local Section).—At the Hotel Metropole, Leeds, at 7.15, Reception and Smoking Concert.

INSTITUTION OF ELECTRICAL ENGINEERS (Glasgow Local Section).—Bath-street, at 8 p.m., ordinary meeting.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION.—At the offices, Balfour House, Finsbury-pavement, E.C., at 2.30 p.m., Special Meeting to adopt new Articles of Association.

FARADAY SOCIETY.—At 8 p.m., in the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, W.C., "New Apparatus for the Rapid Electro-analytical Determination of Metals," by Henry J. S. Sand, Ph.D., D.Sc., and William M. Smalley. Mr. R. W. Paul will exhibit some new pyrometers and resistance thermometers, and some low and high reading ampere-meters, etc.

WEDNESDAY, DECEMBER 14.

JUNIOR INSTITUTION OF ENGINEERS.—7.30 p.m., at the Royal United Service Institution, Whitehall, paper on "Some Recent Developments in Condensing Plant," by Mr. G. L. Kothny, of Manchester.

INSTITUTION OF ELECTRICAL ENGINEERS (Birmingham Local Section).—Birmingham University, at 7.30 p.m., Mr. Haydn T. Harrison on "Street Lighting by Modern Electric Lamps."

INSTITUTION OF ELECTRICAL ENGINEERS (Glasgow Local Section).—Annual dinner.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section).—Victoria Embankment, at 7.30, Mr. J. F. Shipley, "Progress in Arc Lamps."

THURSDAY, DECEMBER 15.

INSTITUTION OF ELECTRICAL ENGINEERS.—Victoria Embankment, W.C., at 8 p.m., Major W. A. J. O'Meara, C.M.G., on "Submarine Cables for Long-Distance Telephone Circuits."

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, at 8 p.m., Prof. H. C. H. Carpenter and Mr. C. A. Edwards, on "The Production of Castings to Withstand High Pressures."

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

AXMINSTER.—A company is being formed to carry into effect a scheme to provide electricity for the town.

BEDFORD.—A proposal is before the Town Council that charges for public electric lighting should be on a higher rate than at present. The proposal would bring in an increased revenue of £508.

BROADSTAIRS AND ST. PETERS.—The District Council is considering the tender of the Electric Tramway and Lighting Company to erect and maintain five arc lamps of between 7,500 and 8,000 c.p. at £10 each per annum, and of the Broadstairs Gas Company to erect and maintain seven high-pressure incandescent gas lamps of 8,400 c.p. each for £6 15s. per annum each.

BRISTOL.—The whole of the administrative sections of the Corporation Electricity Department are now centred at The Exchange, Corn-street, the engineer's and secretary's offices in Temple Back, and the showrooms in Colston-street, having been closed.

CROYDON.—Plans and estimates are being prepared for new mains and transformers likely to be required during the next three years.

DUNDEE.—The supply of cables for the Electricity Departments requirements during the next year, for which the Committee recommended placing an order with the Union Cable Company at last meeting, has been remitted back for further consideration by Council, there being a general opinion that the work ought not to go to a foreign company on such a small difference in price, especially as British manufacturers are handicapped by having to work under a special trades union clause.

LEICESTER.—The Town Council will apply to the Local Government Board for permission to borrow £12,000 for extension of the tramways electricity generating station, in order to supply current for power purposes. Last year £6,000 was expended for this purpose, but the demand is rapidly increasing. In 1908 the committee were supplying 63,000 units, and last year they supplied 1,222,000 units, while this year it will be over two million units for power purposes and six millions for the tramways.

LLANDAFF.—It has been decided to extend the electricity supply to Whitchurch, and to light by electricity one or two of its chief streets.

LONDON, DEPTFORD.—The Council are lighting the branch library in New Cross-road with electricity.

LOUGHBOROUGH.—The municipal electricity department have made a profit of £388 during the past half-year, which compares with a loss of £144 for the same period last year. It has been decided to extend the generating plant at an expenditure of about £2,500 to bring up the output to 200 kw.

PONTYPRIDD.—At a Local Government Board inquiry into an application for powers to raise a loan for electricity works extension, the Taff Vale Railway Company opposed, on the ground that if the price of current had not been reduced from 1½d. to 1¼d. per unit for the tramway, and ordinary consumers were charged more, the necessary capital expenditure could be met out of revenue.

PORTISHEAD.—Messrs. Christie Bros. have deposited plans for the electric lighting of Portishead and District and give formal notice as regards application for Provisional Order.

RIPON.—The City Spa Baths are doing well. From May 1 to the first week in November electricity was used to the amount of 38 units for working the following:—High frequency treatment, ionisation, electric light baths, X-ray department. Electricity was applied in about 900 cases. The cost for current was at 8d. per unit, £1 5s. 4d., while the receipts amounted to £51 0s. 5d.

STOKE-ON-TRENT.—An application is to be made to the Local Government Board for sanction to the raising of a loan of £1,200 for electric mains extension.

ST. MARGARETS.—A Parish meeting has been held with a view to the adoption of the Lighting and Watching Act. It was, however, decided that the adoption of the Act should be subject to the Dover Town Council being willing to supply the parish with electricity, if the Local Government Board consented to an extension of the borough mains from the Duke of York's School to the Parish.

WELLINGTON.—Messrs. J. & W. Purves have decided to postpone applying for a Provisional Order for lighting the town by electricity, but this will be done some time next year.

WINCHESTER.—The Town Council have affixed their common seal to a petition to Parliament for an Act to take over and carry on the electric light undertaking in the city, and Councillor King stated that an agreement had been arrived at with the Electric Lighting Company, although it had not yet been signed, as to the price which the Council should pay for the business. By this means a great deal of money would be saved, and arbitration proceedings would be unnecessary. When the matter had been finally settled, the price would be disclosed.

OVERSEAS.

BOTOSCHAN, ROUMANIA.—The Town Council are asking for tenders for the electrical lighting of the city, and tenders are to be opened on December 31. The work is to be completed within 12 months from January 14, 1911.

BUENOS AYRES.—Laws have been passed empowering the Executive authorities to carry out surveying operations with the object of installing a national system of telephone communications throughout Argentina and voting a sum of 50,000 pesos (about £4,400) to defray surveying expenses; and to erect in the Province of San Juan two telegraph lines to connect the Department of Calingasta with that of Iglesia, passing by way of Castaño. The cost of the work is estimated at 104,716 pesos (about £9,200).

CHILE.—The Government have granted to Messrs. Rafael Ovalle and Gilbert Hodgkinson a concession for providing the town of Rancagua with electric lighting and power. The concession is for a ferm of 10 years. Twelve months are allowed for the completion of the work.

SALTA.—A syndicate has been formed to take over the electric light station of Mr. B. S. Garcia in Salta. The capital is three million dollars paper.

SIMLA.—The Government Hydro-Electric Scheme is going forward rapidly. Tenders are being invited for steel penstocks, Pelton wheels, alternators, exciters, transformers and switch gear.

VENADO TUERTO, ARGENTINE.—It has been decided to adopt the electric light, and tenders for supply will shortly be applied for.

TRACTION.

HOME.

DEWSBURY.—The Town Council are applying to the Board of Trade for a Provisional Order to construct a tramway to Shaw Cross. It is also suggested that the Order should be made to cover an extension from Willans-road to Westboro.

DUDLEY.—The Tramway and Lighting Committee have issued a report stating that the arbitrator had given his award fixing the scale to be paid for current in connection with the tramways in the borough. According to the scale the price to be paid per Board of Trade unit is 1·33d. for supplies ranging from 700,000 to 750,000 units per annum. The prices are reduced from 1·27d. per unit to 1·01d. for quantities between 800,000 and 1,100,000 units per annum. The arbitrator also awards that the Corporation should pay the Tramway Company's costs of and incidental to the reference, and one moiety of the costs of the awards.

LLANDUDNO.—The Llandudno and Colwyn Bay Electric Railway Company have inaugurated a new system of penny fares and also reduced fares for school children.

LONDON, STEPNEY.—The Works Committee recommend that the Borough Council should adhere to their decision not to consent to the proposal of the London County Council to instal the overhead electrical system on the tramways in the Burdett-road and Grove-road, at present worked by horse traction. The Borough Council have contended for some years that the underground, or conduit, system should be adopted.

MORECAMBE.—The year's receipts were £2,035, and the working expenses £1,680. The divisible balance is £662, and a dividend of 2 per cent. is proposed, carrying forward £223. The bill authorising the use of mechanical power on the tramways has been passed, and arrangements are being made for equipping the tramway with petrol cars.

OVERSEAS.

BILBAO.—The Compañia del Tranvia Urbano del Bilbao have applied for a concession for the construction and working of an electric tramway in Bilbao, from the Plazuela de Santiago to the Plazuela de San Nicolas, and also for a similar concession in respect of a line which will run through the Alameda de Recalde and the Alameda de Mazarredo, including a branch through the Calle de Orueta, to the Plaza del Mercado.

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CAIRO.—The Board of the Egyptian State Railways have decided to reconsider the question of using water power from the outflow at the Assouan Reservoir for producing electricity for tractive purposes.

JAMALPUR.—The East Indian Railway Company are opening a separate office for M. H. L. Tyson-Wolff, their electrical engineer, at this junction, where the assistant electrical engineer will also have his headquarters.

OTTAWA.—The "Canada Gazette" of November 12 contain notices of the following applications to the Parliament of Canada:—1. For the incorporation of the Pacific and Peace Railway Company to construct a railway 480 miles long from Bella Coola, on Burk Channel, British Columbia, to Dunvegan, Alberta, with power to generate and make use of electrical power; 2. For the incorporation of the Saskatoon and Hudson Bay Railway Company, to construct a line from Saskatoon to Melfort, Saskatchewan, and the Pas Mission, with power to generate and make use of electrical power; 3, For the incorporation of the Alberta Electric Railway Company, to construct a number of lines in Alberta.

SILESIA.—The Landtag has decided to arrange for the construction of the following railways: (1) Poln-Ostrau-Michalkowitz, (2) Hruschau-Wirbitz-Pudlau-Oderberg, (3) Oderberg-Deutsch-leuten-Polnischleuten-Orlau-Dombrau-Karwin-Freistadt. For those lines which will be worked by electricity suitable generating stations will be erected.

VALLADOLID.—The Sociedad Anonima Tranvias de Valladolid have made application to the Direccion General de Obras Publicas, Madrid, for a concession for the construction and working of an electric tramway in Valladolid.

COMPANIES' MEETINGS AND REPORTS.

BLACKPOOL, ST. ANNES, AND LYTHAM TRAMWAYS.

The annual meeting of this company was held at Blackpool. Mr. Thomas Blane (chairman) mentioned several improvements which are contemplated, including a new car depot and new offices, and emphasised the point that although the expenses for the past year were somewhat heavy, the concern had been worked with the greatest economy. They were somewhat handicapped, he said, by the amount they paid for electricity to the Blackpool Corporation and St. Annes authorities, but they had the satisfaction of knowing that there was no other tramway in the country that could show less consumption of electricity per car mile, a state of things which had been brought about by the payment of bonuses to the car-drivers.

The report was adopted. Mr. T. M. Smith, of Preston, was re-elected a director.

ISLE OF THANET ELECTRIC TRAMWAYS.

Lord Arthur Butler presided over the ordinary general meeting of the Isle of Thanet Electric Tramways and Lighting Company (Ltd.), and in moving the adoption of the report said that it afforded the directors great pleasure to submit a statement of accounts for the year ended September 30 last, which they considered to be the most satisfactory yet placed before the shareholders. (Hear hear.) Since they met a year ago the position of the company had improved in every respect, and they hoped and believed that that improvement would continue. The passenger receipts for the year showed the substantial increase of £2,550, and although the number of visitors to the Isle of Thanet was said to have been greater than usual, the weather up to the end of August was not equal to an average from a tramway point of view. The receipts from the sale of electricity increased by £873, which was a gratifying result having regard to the fact that the introduction of the metallic filament lamp had checked the growth in the consumption of current in the case of a good many electric lighting companies. The total receipts had increased by £3,264 for the year. The details of the expenditure account gave equal cause for gratification. He gave particulars as to where savings had been effected. Out of the available balance it was proposed to pay a dividend on the Preference shares of 2½%, and to place £2,500 to the general reserve, bringing that item up to £11,000. They appropriated £2,500 to future maintenance of permanent way and carried forward a balance of £2,277. He trusted the shareholders would approve of that conservative policy in dealing with the profits. The directors believed that the financial arrangements which they made to tide the company over a period of temporary depression were the best in the circumstances, and were justified by results. They were able to borrow from their bankers at a much lower rate of interest than would have been entailed by the issue of Debentures at a discount or by the creation of a prior lien charge, which at one time was urged upon them by some of the shareholders. They had since largely reduced the bankers' loan. Altogether he congratulated them on the improved position of the company's affairs and expressed the hope that the current year's results would show a still further advance.

The report was adopted.

COMPANIES REGISTERED.

M. CLARK & COMPANY.—£20,000 (£1) (100 founders' and 20,000 ordinary). Contractors for and managers of public and other works and conveniences, including railways, tramways, docks, electric light works, telegraph, telephones, markets, etc. Private. Dashwood House, 9, New Broad-street, E.C.

ELECTRIC TRAIN LIGHTING SYNDICATE.—£5,200 (£1). To acquire certain patents relating to the lighting of trains, tramcars, and other vehicles by electricity. Private.

THE FORMATION SYNDICATE (LTD.), 132, West Regent-street, Glasgow, to carry on business as an electric light company in all its branches, and to generate, accumulate, distribute, and supply electricity. Share capital, £1,500 in shares of £1 each. Private.

PERSONAL.

Mr. Ernest H. Lamb, C.M.S., A.I.E.E., director of the Yorkshire Private Telephones, Ltd., has been returned to Parliament as member of Rochester.

Mr. C. M. Davis, of the Tynemouth Electricity Department having been given the former appointment (engineer and canvasser) and Mr. T. B. Stoddart at present with Messrs. Wm. Drysdale & Company, contractors, Duke-street, Barrow-in-Furness, and formerly with Messrs. The Edison & Swan United Electric Company, Ltd., of Newcastle-on-Tyne, having been appointed as showrooms attendant.

Mr. T. A. Nunwick, for many years chief representative for Messrs. Dorman & Smith, has resigned that position to take up a similar appointment on the staff of Messrs. Parmiter, Hope & Sudgen, Hulme Electrical Works, Manchester. This necessitates his relinquishing the various agencies which he has held during the past two or three years, but as Messrs. Parmiter, Hope & Sugden are the selling agents in Lancashire, Yorkshire, Cheshire and North Wales for the Gilbert Arc Lamp Company, Ltd., Chingford, and also for Messrs. Metalite, Ltd., London, he will represent these firms also. Mr. Nunwick commences his duties on Monday, December 5.

MEXICAN ELECTRIC POWER PROJECT.

According to the "Pall Mall Gazette," a gigantic electric power project is about to be developed on the west coast of Mexico. Three power plants are to be established on the Mayo, Humaya, and Santiago rivers at an estimated cost of 6,000,000 dols., and the plans are already prepared. The company carrying out the scheme owns 115,000 acres of agricultural, mineral, and timber lands, and has concluded a contract with the Harriman interests in Mexico for the supply of electric power to operate some of the lines of the Southern Pacific Railway. The transmission lines will extend from Guaymas to Santiago, a distance of 1,200 miles. Twenty cities along the west coast, where there are tramways operated by horse power, have been approached with regard to the electrification of their lines, and there are a number of narrow-gauge railways leading to the more isolated lines which are likely to make use of the company's electric service.

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ELECTRICITY IN HOSPITALS.

New Installation at the Birmingham Hospital for Skin Diseases.

A thoroughly well-equipped electrical department has now been opened at the Birmingham and Midland Hospital for Skin and Urinary Diseases. It should be stated that electric plant for the treatment of lupus, cancer, and other skin diseases was first installed at the hospital nine years ago, but owing to the growth in the importance of the department and the increasing number of patients treated it has been found necessary from time to time to enlarge the accommodation provided for this branch of the institution's work. The department began in a small room in the basement, and afterwards the Board Room was enlarged and placed at the disposal of the medical staff for this purpose, while the electrical equipment was increased. Three years ago it became apparent that more room was required, and a new and well equipped department has been constructed in the basement of the building at a cost of £2,000. The plant installed includes three complete sets of X-ray apparatus for purely therapeutic work, these being capable of adjustment to give varying qualities of Crookes' tube emanations. A great deal of attention has been paid to the protection of patients and the staff from the undesirable effects of the X-rays. It has been found that the method of enclosing patients with the apparatus in a cubicle has been very trying to timid persons, and especially to children, and as the result of important experiments conducted at this hospital a shield has been devised for interposition between the patient and the Crookes' tube. This shield consists of a sheet of metallic lead a quarter of an inch in thickness, which is perforated in one place to allow of the passage of the rays. It has been found possible to so dispose the lead that the passage of the current through the X-ray tube is not sensibly affected The operators are shielded behind screens lined with sheet lead and furnished with windows of thick lead glass. It is of interest to note that since the department was first established nine years ago no member of the medical or nursing staff of the hospital has contracted X-ray dermatitis, and the committee naturally desire that no effort should be spared to preserve this reputation. In addition to its valuable action in lupus, rodent ulcer, and other chronic affections of the skin, the X-ray apparatus has been extensively used at this institution in the treatment of ringworm, and has reduced the average period of treatment in such cases from three years and three months to three months or less. The Finsen-Reyn and Lortet-Genoud lamps used in the department are adapted for utilising the highly actinic rays of the electric arc in the treatment of the more superficial skin diseases. The high frequency apparatus installed is by Gaiffe, of Paris, and is the most powerful of its kind. By its use over 1,000 milli-amperes pass quite painlessly through the human body. It has been found a most useful treatment for certain forms of lupus and other chronic skin ailments. For rapid radiography and the diagnosis of diseases capable of being so diagnosed, a coil is provided capable of taking a current of from 60 to 70 amperes at 220 volts. Electrolysis, and ionization are other forms of electrical treatment provided for in the department, while the extension scheme has also enabled a room to be provided for complete bacteriological, chemical, and other examinations. The department is under the control of Dr. Russell Green, and the committee claim that the hospital has now the finest equipment of scientific apparatus in the Midlands. They appeal, however, for funds for the purchase of radium.

STREET LIGHTING BY MODERN ELECTRIC LAMPS.

By Haydn T. Harrison.

The following discussion took place on the reading of Mr. Harrison's paper (reported fully in THE ELECTRICAL ENGINEER, December 2), before the Manchester Local Section of the Institution of Electrical Engineers.

Replying to some remarks of Mr. S. L. Pearce, Mr. HARRISON said his experience was that the series lamps lasted longer than the parallel lamps. This he attributed to the greater strength of the low voltage filaments.

Mr. SEATON drew attention to, among other things, the absurdity of lighting, with incandescent gas, such a street as Portland-street, Manchester, where there is a very considerable amount of heavy motor-hauled traffic. The vibration breaks up the mantles very quickly, and results in half the lamps being continually useless through having broken mantles.

Mr. ANGUS said that at Eccles they had replaced gas by electricity and found the results highly satisfactory. They had about 45 poles per mile, and their charge was £2 8s. 6d. per pole per year for current, lamps, renewals, and attendance.

Mr. A. G. COOPER, of Colne, mentioned trouble he was having in getting enclosed arc lamps to give their full burning hours. He thought possibly the high altitude of Colne might have something to do with this matter.

Mr. J. FRITH thought that one of the most important points in connection with street lighting was the fog penetrating power of the illuminant, and he asked how the lamps described by Mr. Harrison compared with the gas lamps. The position of the lamps with respect to the street walls would have some slight effect on their illuminative value.

Mr. O. MOON mentioned that from figures he had, the average life of Osram lamps taken over the results of 50 towns was 2,000 hours.

Mr. S. J. PECK (chairman) called attention to the effect of globes on the light of the lamp. He mentioned a case of a complaint from people using flame arcs with clear globes, and with opalescent globes; that the clear globe lamps were not giving anything like as much light as the other lamps. On investigation it was found that the actual illumination was much better with the clear globes, as might have been expected, but the opalescent globe, looking like a ball of fire, appeared to the eye to be much brighter. The globes of incandescent lamps were receiving great attention in the States from the point of view of their effect on the light given out.

Mr. F. SELLS raised a very important point. The author, he said, had dealt only with large systems of street lighting. If electricity was really so much better than gas, why was not gas driven out of the field? He thought it was because the case of the small town was different. He wanted to know the cost of service and lighting for small towns. The Osram series lamps as a rule were not of so long a life as the parallel lamps.

Mr. HARRISON, replying, said that in fogs the tungsten lamp and the flame arc lamp were best; the enclosed arcs were no good under the conditions. In successful street illumination the great thing was to get rid of glare. His reflectors did this very effectively while giving the correct light distribution. The small cut-outs he had mentioned worked on 2 watts. The cost of lamp renewals for the Osrams was much less than for the original gas mantles. In this case, however, as the contract was particularly stringent as to the maintenance of the candle-power, the gas mantles were renewed oftener than was usually the case.

Replying to Mr. Sells, the reason why gas was not killed altogether, was not because it was actually cheaper, but because in the small places they had not the money to spend on the change. The Local Government Board would not sanction the change on the score that gas was good enough. "If they existed in the days of oil lamps they would not have sanctioned gas."

CATALOGUES.

Siemens Bros. & Company, Ltd.: Vulcanized India-Rubber Wires and Cables.

Siemens Bros. Dynamo Works, Ltd.: Revised Price List of "Onewatt" Lamps.

Schaffer & Budenberg, Ltd.: A Novel Mechanical Light-Feed Lubricator.

Callender's Cable and Construction Company, Ltd.: Pamphlets No. 1, Rubber-Wire Store Racks; 2, Patent Jointer's Hand Cart; 3, "Kalanite"; 4, "Kalbitum" Paint; 5, Safety Fireproof Cables; 6, "Marine Glue."

G. Braulik: Pamphlet No. 9, Electrical Novelties; No. 10, The Metallic Filament Lamp.

S. H. Heywood & Company, Ltd.: Electric Cranes, Overhead Travellers, Fixed and Walking Jibs, etc.; Goliaths and Wharf Cranes.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 149, Fleet Street, London, E.C.

TENDERS.

EAST HAM CORPORATION.

GENERATING AND CONDENSING PLANT.

The above-named Corporation invite tenders for the supply and erection of the following machinery at the Electricity Generating Station, Nelson-street, East Ham, E.

SECTION "A."

One 1,000 kw. Triple-expansion Medium-speed Engine and Generator complete.

SECTION "D."

One Evaporative Condenser for 40,000 lbs. of steam per hour, with Air Pumps, Circulating Pumps, all Piping Valves, Connections and Auxiliaries.

Persons tendering are at liberty to tender for either of the sections, but not for a part only of either section.

Copy of specification, with general conditions and form of tender, may be obtained on application to the Engineer and Manager, M. W. C. Ullmann, M.I.E.E., M.I.Mech.E., Tramway Depot, Nelson-street, East Ham, on payment of the sum of £2 2s., which will be returned on the receipt of a *bona fide* tender, together with the specification, general conditions and drawings.

The whole of the machinery is to be of the best English manufacture.

Tenders, under seal, are to be sent in addressed to "The Chairman, Electric Lighting and Tramways Committee, Town Hall, East Ham, Essex," and endorsed "Tender for Generating and Condensing Plant," not later than 12 o'clock noon of December 30, 1910, and must enclose a £50 Bank of England note, which will be returned upon the signing of the contract or the rejection of the tender, or will be forfeited if the party whose tender is accepted does not sign the contract.

The firm whose tender is accepted will be required to satisfy the Corporation that Trade Union rates of wages are paid, and Trade Union hours and conditions observed in the course of their general business, to pay to the whole of their workmen such rates of wages and observe such hours of labour as are recognised by the Trades Union, to supply the Corporation with the schedule rate of wages adopted by them, and to enter into a Contract with a bond for the due and proper performance thereof.

The Corporation does not bind itself to accept the lowest or any tender.

(By Order),
C. EUSTACE WILSON,
Town Clerk.

Town Hall,
East Ham, E.
December 6, 1910.

COUNTY OF LONDON.

The London County Council invites tenders for certain high and low tension switchgear.

Persons desiring to submit tenders may obtain the specifications, drawings, bills of quantities, form of tender, etc., from the Clerk of the Council, County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of £2. This amount will only be returned if a *bona fide* tender is submitted. Full particulars of the work and conditions of contract may be obtained at the County Hall before the payment of this fee.

The Contractor will be bound to pay to all workmen employed by him in and about the execution of the contract, or any part thereof, wages at rates not less, and to observe hours of labour not greater, than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule. Full particulars of the Council's Standing Orders on these matters are given in the London County Council Gazette.

Tenders must be upon the official forms and the instructions therein must be strictly complied with.

No tender received after 11 a.m. on Tuesday, January 10, 1911, will be considered.

The Council does not bind itself to accept the lowest or any tender, and it will not accept the tender of any person or firm who has withdrawn a tender after the same had been opened unless the reasons for withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall, Spring Gardens, S.W.
December 5, 1910.

APPOINTMENTS.

COUNTY OF LONDON.

The London County Council invites applications for the position of Laboratory Steward at the London County Council Paddington Technical Institute, Saltram-crescent, W. Candidates must have had experience in physics laboratories. Salary £2 2s. a week.

Applications should be made on Form T.17, which can be obtained from the Education Officer, London County Council Education Offices, Victoria Embankment, W.C., to whom they must be returned not later than 11 a.m. on December 17, 1910, accompanied by copies of three testimonials of recent dates. All communications on the subject must be marked T1. and a stamped addressed foolscap envelope must be enclosed. Canvassing, either directly or indirectly, will be held to be a disqualification for employment.

G. L. GOMME,
Clerk of the London County Council.

Education Offices,
Victoria Embankment, W.C.
December 6, 1910.

AN ASSISTANT ENGINEER wanted for the Chief Electrical Engineer's Department in a leading Railway Company abroad. Age between 28 and 33 years (approximately). Candidates must have had (a) sound technical training with at least 10 years' subsequent practical experience in both mechanical and electrical work, including erection and running of installations; (b) responsible charge of men and handling of materials; (c) experience in designing, drawing office, specification and estimating, (d) experience in technical and general correspondence.

The selected candidate would be required to pass the Railway Company's medical inspection. Canvassing will be a disqualification. Salary about £750 per annum.

Further particulars may be obtained by letter only from Mr. J. F. C. Snell, M.Inst.C.E., Messrs. Preece, Cardew & Snell, 8, Queen Anne's Gate, S.W.

CONTRACTS OPEN.

HOME.

BARKING TOWN.—The Urban Council invite tenders for the supply and erection of (A) 400 kw. Diesel engine and dynamo; (B) 250 kw. motor generator; (C) traction battery and reversible booster; (D) main switchboard and connections; (E) overhead travelling crane. Particulars from the Municipal Electrical Engineer, Barking, Essex. December 20.

BISPHAM-WITH-NORBRECK.—The Urban Council invite tenders for the erection of buildings and other works in connection with their Electrical Generating Station in Red Bank-road. Particulars (21s.) from the Surveyor. December 12.

BIRMINGHAM.—The Corporation invite tenders for the supply and erection of 60 electric tramway cars. For particulars, apply to General Manager, Tramways Department. December 12.

BOURNEMOUTH.—The Corporation invite tenders for the erection of 1¼ route miles of overhead construction. Advt. in this issue. Specifications, etc., obtained (deposit £2), from Mr. C. W. Hill, Tramways Manager.

ISLINGTON.—The Borough Council invite tenders for the supply and erection of high-tension switchboard for generating station. Particulars from Chief Electrical Engineer, Eden-grove, Holloway. January 12.

LEYTON.—The Urban Council invite tenders for the supply and erection of a 600 kw. mixed pressure steam turbine set with all accessories. Specification, etc., obtained (deposit two guineas), Mr. F. H. Lewis, Electricity Station, Cathall-road, Leytonstone.

LONDON.—The London County Council invite tenders for high and low tension switchgear. Particulars (40s.) from the Clerk of the Council, Spring-gardens, S.W. January 10.

RAWTENSTALL.—The Corporation invite tenders for the extension and alterations to the municipal tramway depot. Particulars from the Borough Surveyor. December 13.

OSRAM·LAMPS

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ROTHERHAM.—The Corporation invite tenders for (1) high tension feeder, (2) rotary convertors, transformers and switchgear. Particulars (42s.) from the Borough Electrical Engineer. December 13.

OVERSEAS.

BRISBANE.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up to noon on January 4, 1911, for the supply of (1) poles and ironwork (Schedule No. 141), and (2) 17 magneto switchboards (Schedule No. 142). A deposit will be required with each tender. Local representation is necessary. January 4.

CALGARY, CANADA.—Tenders are invited by the Calgary City Commissioners for the supply of a synchronous motor generator of 1,500 h.p. and also of a motor generator exciter set, including switchboard, instruments, etc. Tenders will be received by the City Commissioners, Calgary, Alberta, up to noon on December 22. A deposit of 2½% of the value of the offer must accompany each tender. Copies of the specifications may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

CONSTANTINOPLE (Extension of Time).—The Municipality invite tenders for the construction and working of electric tramways in Constantinople and suburbs. Extension from November 10 to December 20.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley-system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham House, Old Broad-street, E.C., and Central House, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a *bona-fide* tender.

JERUSALEM.—The Municipality invite tenders for (2) electric tramways and electric lighting installations in the town; (4) telephone installation at Jerusalem, Jaffa and Bethlehem. Tenders in respect of each of the above schemes will be received by the municipal authorities up to December 31. Local representation is desirable.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 5¼ miles of lead-covered, paper-insulated telephone cable (Schedule No. 407). A deposit will be required with each tender. Local representation is necessary.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 10, 1911, for the supply of 200 contacts, plug seat, and 2,350 condensers (Schedule No. 402). A deposit will be required with each tender. Local representation is necessary. January 10.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

TAIHAPE, NEW ZEALAND.—Tenders are invited by the Taihape Borough Council for the supply and erection of a hydro-electric lighting and pumping plant. Tenders, marked "Tender for Electric Plant," will be received by the Town Clerk, Taihape, N.Z., up to 5 p.m. on January 11, 1911. A deposit of £130 must accompany each tender.

TENDERS ACCEPTED.

BELFAST.—Town Council, British Insulated & Helsby Cable Company, for supply of cable.

BOLTON.—Guardians, wiring at the Workhouse, Messrs. Townson & Chadwick. £70 15s.

BRIXHAM.—Messrs. George Schultz & Company, of 10, Bush-lane, London, E.C., have secured the contract for the Brixham electric installation of machinery, etc., for the lighting of Brixham by electricity, an undertaking to be carried out under the Brixham Gas Company.

CROYDON.—The Council have accepted Messrs. Ferranti's tender for the supply of meters until March 31, 1912.

DERBY.—Town Council. Tramcar meters, fixing and maintenance; Chamberlain & Hookham, Birmingham. £152 15s.

KENDAL.—St. George's Church. Lighting; Gilkes & Company. £94.

LLANDUDNO.—The Urban Council have accepted the tender of Mr. L. Roberts to construct a pit for the coal conveyor hopper at £67 13s. 2d., and that of Messrs. T. Parry & Company for the supply of 3,000 tons of coal for the electricity works.

PETERBOROUGH.—Town Council. Electric cables, callenders. Cable and Construction Company, Ltd. £397 2s. 7d.

STRATFORD, E.—Wiring Salway-place schools, Stannos system, for West Ham Education Committee; West Ham Corporation, Electricity Dept. £146 2s.

WALSALL.—The Town Council. Tenders accepted:—Bennis & Company, two coal elevators, together with driving shaft, £175; British Westinghouse Company, transformer, £74, switchgear and meter, £57 10s.; Union Electric Company, two E.H.T. switches, £12 12s.; Electric Power Storage Company, removal, overhauling, and cleaning St. George's Hall Sub-station battery and re-erecting same at Darwell-street, £79, plus new plates.

WORKSOP.—Town Council. Purchase of 50 c.p. lamps for street lighting; General Electric Company, Ltd., at 3s. 9d. each, (recommended). 50 prepayment meters at 42s. 6d. each; The Mordey Fricker Electricity Company, Ltd.

NOTES.

Osrams in a Motor Smash.

Osram battery lamps are now in high favour amongst the motoring community on account of their economic principles and are very largely used for the lighting of cars and for the searchlights and tail lanterns; but it is not often they are called upon to pass such a test of "reliability" as is recorded by the following facts.

A very well-known central station engineer whilst motoring in the South recently experienced a bad side-slip, which caused his car to charge a bank and turn over. The first thing to strike the ground was the off searchlight,

which was recovered from the wreck in the exact condition shown by the above illustration. Not a particle of the lens or front glass remained in the body of the lamp, the only real survivor being the "Battery" Osram.

Out of curiosity the engineer in question switched on the car lamps after the smash and was surprised to see the Osram lamp light up in the pulverised searchlight.

This lamp had already been in service since June, 1909, and, therefore, we think, in every way has justified its name.

"Onewatt" Progress.

Messrs. Siemens Bros. Dynamo Works, Ltd., are now placing upon the market a 200 c.p. "Onewatt" lamp, which is made for voltages from 100 to 130 and 200 to 250 in 200 c.p. The efficiency of the lamp will, we understand, be precisely the same as that of the 100 c.p. "Onewatt" lamp at present on the market, and the filaments are made of drawn Tungsten wire. As the characteristics of the new lamp are exactly the same as the previous lamps they should enjoy the same popularity. They will be supplied with E. S. or B. C. caps as required in spherical bulbs only, the sizes of which will be 9⅞ in. long by 6¾ in. diameter. Other types of "Tantalums" are also "going strong." The firm have just obtained the largest contract for metal filament lamps for ship lighting which has been placed since the introduction of metallic filament lamps. This order has been placed by one of the largest ship

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.
Sculcoates,
HULL.

builders in the United Kingdom, which proves very clearly that engineers engaged in ship lighting and traction work are appreciating the strength of filament and great saving in current consumption combined with the general good qualities of "Tantalum" lamps.

Electric Kleenall.

The General Electric Company, Ltd., have brought out a book giving particulars and illustrations of the "Electric Kleenall," a new and very good selling line which they are just placing before the trade. It is a wonderfully serviceable, handy, robust and reliable article, which should find a very wide welcome, particularly as it sells at a reasonable commercial price well within the reach of all users of electricity. It requires no special fitting, is supplied for direct or alternating current, and can be used wherever electric light is installed. The manufacturers, we hear, intend to extensively advertise this article throughout the country, so dealers could well take this up without hesitation. The Electric Kleenall as now sold,

FIG. 1.—ELECTRIC "KLEENALL."

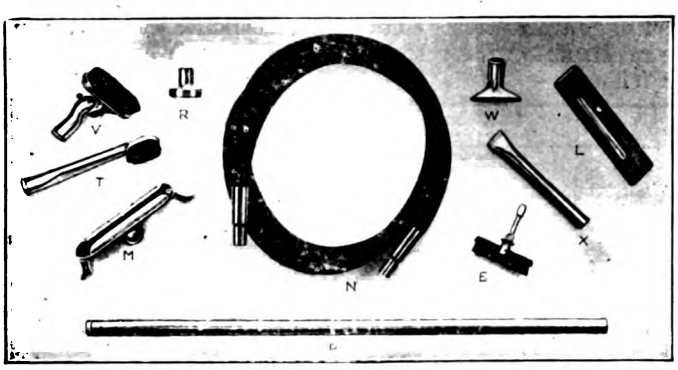
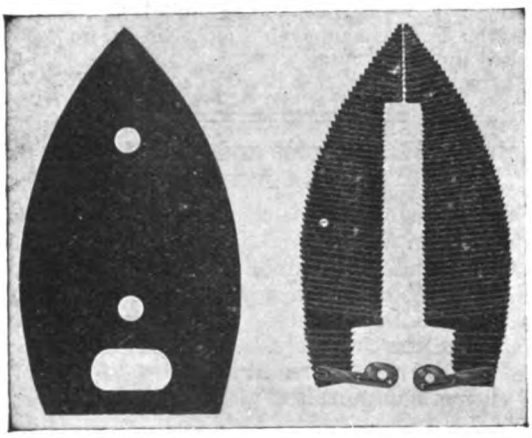


FIG. 2.—SPARE ATTACHMENTS.

and illustrated here, embodies improvements over the type placed by them on the market some months ago. It is an article which we think should find quite a large sale at this time of the year, and no doubt many contractors would like to push it as a "suitable Christmas gift."

The Useful Flat Iron.

The British Thomson-Houston Company, Limited's, latest price list (No. 258) deals with the B. T. H. "Calorite" electric flat irons. These electric flat irons are made in various sizes, suitable for all kinds of light or heavy ironing, from valuable and delicate embroideries to leather and tailoring work. They are of attractive finish, high efficiency and inexpensive. The heating unit, which is of "calorite" metal, is capable of withstanding oxidation to a point several hundred degrees higher than any metal previously used in heating devices, and is practically indestructible. As an instance of this a B. T. H. "Calorite" flat iron has been on circuit continuously day and night for nearly



four weeks, and although the wooden handle has entirely disappeared, the heating unit is still intact. As will be seen from our illustration, the heating unit is so distributed that heat is supplied exactly where required: at the point, heel and sides. While the component parts are few in number, they are easily interchangeable.

OPENINGS FOR TRADE.

Plant, Wiring, Fittings, Accessories, etc.

CENTRAL STATION EXTENSIONS, ADDITIONS AND PROJECTS.

Agreed Upon.

Dartford, Lewisham, Southampton—Tramway extensions.
Dover Stokers—£550.
London, Southwark: Extensions—£6,900.
Newport (Mon.) extensions—£31,000.

Contemplated.

TOWN COUNCILS.

Aberdeen: Generating station and destructor works.
Basingstoke: Destructor—£2,000.
Blackpool: Tramway extension.
Carlisle: Extensions, lighting.
Carnarvon: Lighting—£1,990.
Dover: Cables.
Dundee: Tramway extension.
Edinburgh: Extensions, plant, etc.—£37,000.
Harrogate: Extensions.
Hull: Tramway extension.
Ipswich: Extensions, light and power.
Leicester: Electricity Works extensions, cables, etc.—£12,000.
Loughborough: Extension, generating plant—£2,500.
Lowestoft: Plant—£2,900.
Stockport: Extensions and plant—£20,000.

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URBAN DISTRICT COUNCILS.

Erith: Osram lamps.
Finchley: Electricity works—£10,000.
Heckmondwick: Electricity works—£24,000.
Leek (Ireland): Plant—£4,000.
Pontypool: Sun arc lamps.
Sevenoaks: Central station.
Witney: Are acquiring the Witney Electric Supply Company, Ltd., and intend carrying out extensions.

PRIVATE COMPANIES.

East Kent Electricity Company, Ltd., Ashford: Tramway extension.
Fife Electric Tramways Light and Power Company, Ltd.: Lighting Fife District.
High Wycombe: Electric Light & Power Company, extensions, lighting.
Malvern, Mersham, and Purley: Railless electric traction.
Sandwich, Deal and Walmer: Electricity Supply Company, Ltd., electricity works.
South Lancs.: Tramways Company, extensions.

Constructional and other work will shortly be carried out by or for the following authorities or firms. The amount mentioned is the contract price in each case.

Brighton: Borough Surveyor. Rebuilding of 7, Gloucester-place.
Coventry: B. Ault. Erection of Children's Home, £710 9s.
Cradley Heath: J. Bridgwater. School, £9,136 14s.
London, Marylebone: Proposed erection of Town Hall.
Morley: J. A. Buttery, architect, Queen-street. Extension of Parkfield Mills.
Nuneaton: T. Smith. Isolation Hospital, £2,136 7s. 11d.
Plymouth: Borough Surveyor. Erection of stables, cart-sheds, smithy and dwelling house.
West Bromwich: Dallow & Sons. Schools, £5,875.

"Tantalum" Fire Brigade and Staff Annual Supper and Concert.

The annual supper and concert of Messrs. Siemens Brothers Dalston Works Fire Brigade and Staff was held at the Crown and Castle Hotel, Dalston, on Friday last, December 2. The chairman was Mr. J. Snow Huddleston, manager of Cable Dept., and the proceedings were restricted to members of the firm only. The whole selling force of "Tantalum" lamps was present and proved that they were equally energetic in pursuit of pleasure as they are in business. At 7.30 p.m. a very excellent menu was provided and after having satisfied the inner man, an attractive musical programme was arranged. By the kind permission of Walter Gibbons, Esq., of the London Theatre of Varieties, the following artistes appeared:—Rosie Gaster (comedienne), Billie Hobbs (comedy purveyor), Freddy French (eccentric comedian), Harry Rogerson (the tired comedian), and C. J. Johnson (the Black Diamond), all of whom contributed highly amusing turns, which were greatly appreciated. The turns of Miss Rosie Gaster were very enthusiastically received and were quite the feature of the evening. Jack Millard, Esq., also contributed some exceptionally humorous items, including "Socialism" and "Snapshots." Mr. Roger Parker was in fine form with his Scotch turns, and Mr. R. E. Hinton, a former member of the firm, was also well received, whilst Mr. D. C. Meffan charmed the audience with his tenor songs. The chairman, in proposing a vote of thanks to the committee and secretary, said that he was very glad to be present as a member of the oldest branch of the firm to help the youngest branch of the Siemens firm at Dalston, which showed signs of being very much alive. A vote of thanks to Mr. Adams for his assistance in procuring the artistes, and the artistes themselves, was also carried unanimously. The whole evening passed off very pleasantly, and was a testimony of the good feeling which exists between all departments of the firm.

ELECTRICAL ENGINEERS TERRITORIALS (London Division).—Orders for week ending December 17, 1910:—Officer commanding, Col. H. M. Leaf. Monday, December 12, "A" Co., Technical Drill, 7 to 10 p.m. Tuesday, December 13, "B" Co., Technical Drill, 7 to 10 p.m. Thursday, December 15, "C" Co., Technical Drill 7 to 10 p.m. Friday, December 16, "D" Co., Technical Drill 7 to 10 p.m. (Signed) P. H. Campbell, Capt. R.E., Adjutant.

L. & N. W. R.

THE BUSINESS AND PLEASURE LINE.

CHRISTMAS & NEW YEAR EXCURSIONS FROM

EUSTON

and other London Stations.

TO	DATE. DECEMBER	FARES FROM s.	d.
IRELAND - - - - -	23rd	24	0
SCOTLAND - - - -	23rd & 30th.	24	9
Liverpool, Manchester, and Leeds Districts - - - Blackpool, English Lakes - North, South, and Central Wales, also Cambrian Line - Bolton, Blackburn, Colne, and other Stations on the L. & Y. Line - - -	23rd & 24th / 24th	16	0
North Staffordshire District -	24th	13	0
Birmingham District - -	24th	11	0
	26th	7	0

Week-end Tickets will be issued on Friday and Saturday, December 23rd and 24th, to numerous Holiday Resorts (including Scotland), available for return on the following Sunday, Monday, Tuesday, or Wednesday.

For full information and particulars of Local Excursions obtain Pamphlet at any of the Company's Stations or Town Offices, **or write to the Enquiry Office, Euston Station, London, N.W.**

FRANK REE,
General Manager.

December, 1910.

NEW ZEALAND HYDRO-ELECTRICS.

We have already referred to the New Zealand Government's schemes in connection with the systematic development of water power. We now give particulars of a Bill introduced into the New Zealand legislature providing for an expenditure this year of £500,000 in the development by State enterprise of the chief sources of water-power in the Dominion, which the Government intend to retain in their own hands. In moving the second reading of this Bill, the Prime Minister gave an outline of the works which it is proposed to execute in the course of time at Kaituna, Wairoa, the Hutt, Lake Coleridge, the Teviot, Lake Hauroto, Lake Makuri and on the West Coast, as follows:—

Place.	Capacity.	Cost.
	h.p.	£
Kaituna (for Auckland district) ..	10,000	320,000
Wairoa Falls (north of Auckland)	3,000	100,000
Lake Coleridge	10,000*	270,000
The Hutt (for Wellington district)	10,000	300,000
The Teviot (for Otago)	10,000	300,000
Lake Hauroto (for Southland)	10,000	350,000
Makuri Gorge	6,000	200,000
West Coast..	3,000	75,000

* Together with headworks for an additional 28,000 h.p.

It is proposed, further, to electrify the railway through the Lyttelton-Christchurch tunnel.

The execution of the Lake Coleridge, Kaituna and Hutt schemes is to be begun practically simultaneously.

PATENTS.

Arc Lamps.

2263.—1910. H. C. BLACKWELL, Sale. The movable coil of the lamp has a movable iron core. The coil and core are suspended from fixed centres by means of links and rocking bars, so arranged as to permit of their moving freely to or from each other.

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Electric Conduits.

24561.—1909. L. Milne, Westminster. This is an interrupted tubular electric conduit in which each conduit end is increased in external diameter and connected to a tube of greater diameter than that of the conduit. The disconnection of the tube and conduit ends is effected by an angular rotation of the tube.

Electrolytic Apparatus for the Production of Pure Oxygen.

24716.—1909. R. Eycken, C. Leroy, and R. Moritz, Wasquehal. In this apparatus conduits are made at the top of the electrode plates. These conduits have no joint in common with the electrolysing cells proper, all the joints being bounded by the outside atmosphere.

Electrical Heating Apparatus.

24813.—1909. A. F. Berry, Ealing. The apparatus comprises carriers in the form of segments of a disc of thin clear sheet mica disposed between a recessed plate and a heating plate provided with openings at the centre through which the ends of the windings are passed.

Electric Radiator.

24829.—1909. A. Trepreau, St. Mande. This radiator is arranged as a screen and is provided with a series of glass tubes open at both ends and held in a frame. A wire of uniform section is disposed in the tubes and insulated by air. The regulation of heat is effected by dividing the radiator into several sections which may be energised at will.

Dynamo Electric Machines.

25144.—1909. A. K. T. Smith, Dulwich Common, S.E. This machine comprises a central core with limbs of magnetic material arranged along its sides, and a reciprocator in the form of a coil movable on the core. The reciprocator is of less length than the air gap in which it moves. Magnetising windings are provided for the core, or the core may be permanently magnetised.

Submarine Sound Signalling.

25191.—1909. J. Gardner, Fleetwood. This is a microphone device for use at a receiving station for submarine signalling. It consists of a resonating vibratory ring diametrically attached to a diaphragm and carrying the microphone electrode.

Direct Current Electric Motors.

25230.—1909. J. Lecoche, Westminster. One of the pole pieces of this continuous current motor consists of the laminated rim of a wheel, the shaft of which is perpendicular with the armature shaft. The rim presents hollow teeth corresponding to the threads of the screw armature.

Electric Arc Lamps.

29069.—1909. H. Hirst and A. E. Angold, Salford. This is an improvement in lamps of the abutment type and consists in the arrangement of a combined clutch and guide which travels on a guide rod and is pivoted to the holder of the abutment carbon. An arm extends from the guide frame of the other carbon. The end of the arm rests on the clutch lever of the abutment carbon and causes it to grip the guide rod whereby the weight of the sliding frames and guiding parts is taken off the abutting carbon which is allowed to burn to such a shape that the arc is well removed from the abutment.

Control Apparatus for Vapour Electric Devices.

1483.—1910. H. M. Scheibe, Wilkinsburg. The starting magnet for tilting the container in order to bring two electrodes into contact for starting an arc within the container, is provided with an opposing coil which reduces or neutralises the action of the actuating coils, and is effective only when the container is tilted so as to immediately permit the restoration of the container to its original position.

Combined Trolley Wire Hangers and Automatic Circuit Breakers.

3383.—1910. R. G. Winters, Chicago. The hanger comprises a body of insulating material, shafts mounted in opposite ends of the body, contact arms rotatably mounted on the shaft and adapted to receive the conductors, and means to slide and rotate one of the arms automatically to break the electric circuit through the hanger when one of the electric conductors break.

Burglar Alarms.

2824.—1910. A. Bloch, Paris. The alarm comprises a polarised magnet, each pole of which is influenced by a coil. One coil is interpolated in a control circuit, while the other coil is interpolated in a special circuit. The armature of the magnet is spring suspended between the two poles. The whole apparatus is so arranged that the armature closes the alarm circuit by striking against an adjustable terminal whenever the control circuit is closed.

Positive Electrodes for Accumulators.

3631.—1910. M. Schneider, Dresden. Helical or spiral leaves are formed on the bars of a skeleton core and project from the outside of the bars. The electrode is placed on a rotating mandrel and paste applied to it by means of a spreading tool which follows the helix or spiral curves and spreads the paste in one operation.

Railway Signal Systems.

3982.—1910. General Electric Company, Schenectady, U.S.A. This is an improvement in signalling systems in which the rails of adjacent blocks are separated by insulated joints. Resistances between adjacent blocks cross connect a rail of one block with the diagonally opposite rail of an adjacent block to close the back circuit.

Insulators for Overhead Wires of Electric Tramways.

4716.—1910. H. Mc. P. Dudgeon, Aston Manor. The insulators have ears which form grooves at right angels circumferentially to one another for the reception of coupling straps or links. The outside faces of the ears and the insides of the coupling straps are so shaped that when in position for use the straps are partially locked against displacement while the insulator is easily removable bodily.

Electric Soldering Tools.

6523.—1910. Regina Bogenlampenfabrik, G.m.b.H., Cologne-Sülz. These improved tools are composed of an alloy of copper and aluminium. Such tools are claimed to retain their power of conducting heat under the peculiar influence of the electric arc.

Electrolytic Apparatus Having a Liquid Anode.

6597.—1910. Schott and Gen, Jena. Portions of the bottom of the anode vessel are constructed as restraining bodies so as to produce a number of entirely separate component anodes, each of which is provided with separate means for leading in the current.

Electrically Operated Locks.

6915.—1910. T. Dobson, Rochdale. A pair of electric wires are arranged inside the strong room or safe door through a number of switches in such a manner that in combination with a pivoted armature and intermediate mechanism they allow a slidable bolt to be either taken out of or placed in the locking position.

Electro Magnetically Controlled Electric Switches.

7465.—1910. Cutler Hammer Manufacturing Company, Milwaukee, U.S.A. The pivot of the actuating lever is provided with an abutment which is held by the controlling electromagnet in the position that permits closing of the switch arm by means of the actuating lever.

Starting Alternate Current Mercury Vapour Lamps.

8125.—1910. W. C. Heraeus, G.m.b.H., Hanau. In order to start alternate current mercury vapour lamps without the use of an auxiliary anode and without the formation of a short circuit between the anodes on the forward and backward flow of mercury produced by tilting the lamp, the lamp with its mercury vessels are arranged on a tilting axis so that one anode vessel lies lower than the other, and on tilting the lamp mercury will flow from one of the anode vessels towards the cathode and return to the vessel.

Galvanic Batteries.

8810.—1910. Dura Elementbau, G.m.b.H., Berlin. Pumice or other porous substance having a large fluid carrying capacity is mixed with the dry electrolyte of a galvanic battery constructed in accordance with Patent No. 23622—1904.

Working Arc Lamps in Series with Incandescent Lamps.

11581.—1910. A. Heimann and W. Schaffer, Berlin. A starting resistance is switched in front of the arc lamps during the starting period. After lighting the arc lamp the resistance is first connected in parallel with a polarisation battery of small capacity comprising lead plates in diluted sulphuric acid in order to break down the formation of sulphate on the plates of the polarisation battery, by a short shock of current when the lamps are switched on and only being disconnected.

Oxidising Nitrogen by Means of Electric Discharges.

12229.—1910. K. Kaiser, Wilmersdorf. The process consists in adding a small amount of gaseous ammonia to a mixture of nitrogen and oxygen and subjecting the mixture to the action of an electric discharge.

Electric Switches.

12489.—1910. H. E. Dey, Jersey City, U.S.A. This switch comprises two continuous inner and three interrupted outer concentric rings and a pair of arms adapted to sweep over the rings in such a manner as to supply current to a motor and cause it to rotate in one direction or the other as desired, or to cut off the current automatically at the end of the stroke and at a central position when required.

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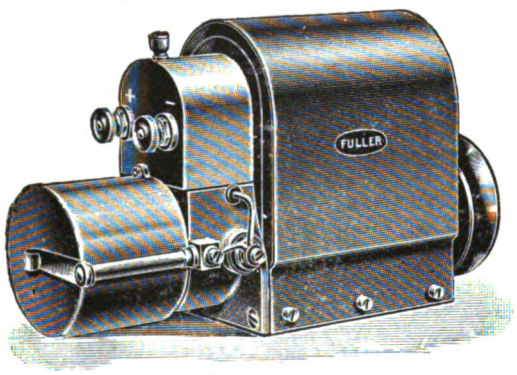
PUBLICITY.

In this Section of "The Electrical Engineer" we give Publicity to New Inventions and Specialities.

Electric Motor Car Accessories, II.

The Fuller patent wireless system of car lighting is designed to facilitate the instant removal of lamps for cleaning purposes, in addition to which there is an absence of loose wires which are sometimes troublesome. In this system, the insulated conductor is enclosed in a metal sheath, which acts as a "return" for the current, the metal being of tinned copper, as to be almost imperceptible.



DYNAMO.

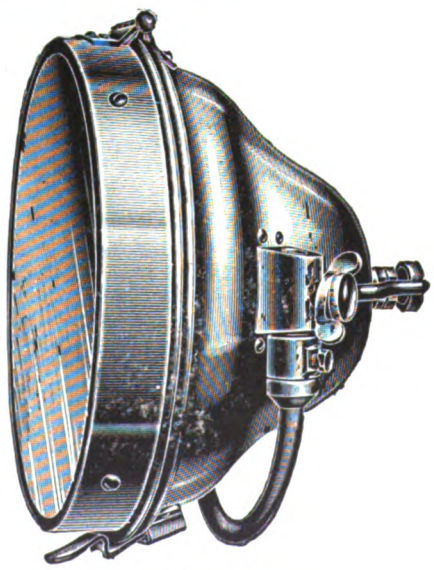
The act of placing the lamp on the bracket, makes contact and this obviates the necessity of connecting and disconnecting wires, a feature which should appeal to motorists.

The Fuller automatic dynamo provides a simple and efficient means whereby the accumulators supplying current to the lamps are automatically charged while the car is running. The control is automatic and depends on two factors—speed and voltage. When the speed drops below the normal, a mechanical governor breaks the circuit, and when the voltage fails, a magnetic circuit-breaker operates, and thus affords an additional safeguard. When the speed is accelerated, the circuit is again completed. This dynamo is very compact and easily fitted; the drive is by means of a V pulley and belt driven off the cardan shaft; but any ordinary form of drive can be used.

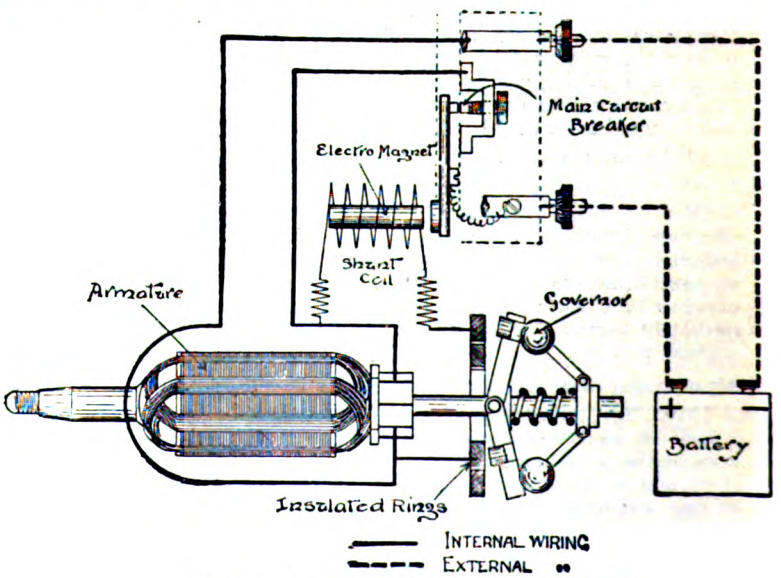
SWITCHBOARD.

SIDE LAMP.

The switchboard is also very compact, the volt and ammeter being combined under one cover thereby economising space. The voltmeter shows the battery and voltage when stationary and the dynamo voltage when running. The ammeter shows the rate of charging, and also serves to indicate whether the dynamo is in circuit when the engine is running. The switch affords complete control over all the lamps; the pointer on the switch showing which lamps are alight.



HEAD LAMP.



WIRING DIAGRAM SHOWING DYNAMO CIRCUIT.

The Fuller system of car lighting should commend themselves to all dealers in electrical accessories.

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NOTES.

Progress in Lighting.

Two important papers have been presented before the Illuminating Engineering Society. That of Professor Howe is dealt with in our leader columns. Dr. E. W. Marchant, of the Liverpool University, was also concerned with metallic filament lamps, but on more general lines. He pointed out that we are fast approaching a time when we may obtain one candle power per watt. Professor Howe's result with his "blackened" globe lamps after over 1,500 hours' service was 2·8 watts per c.p. Another influence on effectiveness touched upon by Dr. Marchant was vibration. It was difficult to get exact data on this, but there seemed little doubt that vibration was injurious, though there was reason to think that its effect had been grossly exaggerated. One might sum up the position so far as metallic filament lamps were concerned by saying that at present there was no difficulty in obtaining a 230-volt metal filament lamp of about 25 candle-power which would give one horizontal candle-power for 1·2 watts and would burn near this efficiency for over 1,000 hours—probably for a much longer period under ordinary conditions.

Ionization in Air.

Another couple of most suggestive papers were read before the Physical Society of London. Dr. A. Russell's subject was "The Electric Stress at which Ionization begins in Air," largely a comment on and a supplement to Professor J. B. Whitehead's observations on the same subject, made in America and dealt with at length in this paper (THE ELECTRICAL ENGINEER, August 12, 1910, page 175). Dr. Russell's experiments confirm the practical bearing of the phenomena. He pointed out that recent research has shown that the voltages between overhead wires at which luminous effects, disruptive discharges, sudden increases in the readings of the ammeters and wattmeters in circuit, and sudden violent ionization begin, are practically the same.

Afterglow of Electric Discharges.

Professor R. J. Strutt described his experiments in connection with the luminosity which follows electric discharges in certain gaseous vapours. It is notable that this does not take place when pure oxygen is used, but is quite marked with ordinary air and still more so when oxygen is added. The phenomena were attributed to the presence of ozone, and this the Professor has proved to be correct by a long series of delicate experiments. The effect appears to be the result of oxidisation due to the action of ozone on some other substance. The whole question seems to have direct bearing upon the problems of illumination by means of luminous gases.

Measurement of Surface Brightness.

At the same meeting of this society Mr. J. S. Dow described a form of instrument, of specially portable and compact design, for the measurement of surface brightness or illumination. The observer looks through an aperture in a white screen, which is illuminated by means of a small glow lamp, at the surface to be studied. The illumination of the screen can then be varied by a special device which gives a uniform scale capable of being calibrated in foot-candles or lux, as desired. The instrument can be calibrated by observing any surface of known brightness and a range of readings from 0·01 to 100 foot candles can be secured. For this purpose two neutral dark glasses, each reducing the incident light to 1-10th, are employed. The device for adjusting the illumination of the screen in the apparatus is as follows:—The small glow-lamp is set within a light-tight white chamber and illuminates a ground opal sector-shaped piece of glass at the end of it, with uniform intensity. Shutters can then be caused to travel in front of this glass, cutting off the area to a known extent and causing a corresponding change in the resultant illumination. The author mentioned some experiences in using the instrument, which can be readily carried about by the observer into any interior and applied to measure illumination or surface brightness in any plane, and in inaccessible places. The instrument, it is suggested, will also be of service in the laboratory on account of its simplicity and ease of manipulation. In commenting upon this, Dr. Russell thought that a photometer of this nature would prove of great value to medical inspectors of schools. It would furnish a means also of telling whether the photometrical observations of street lighting on foggy nights were much affected by absorption.

Factory Electrification.

Speaking to his shareholders, the chairman of the New Pegamoid, Ltd., said that with a view to economy they had substituted electricity for steam in their factory. He added: "It is much more economical, it is far cleaner and in many other ways it is advantageous to us. Early last week I, with my co-directors, was down at the factory, where we examined the arrangements made under the able superintendence of our works manager for the electrification of the whole plant, which we saw in operation. It has been admirably successful: we already find great advantage from it. We have been able to write off the whole of the cost out of the profits of the year, which I think you will agree is very satisfactory. We still use steam for heating purposes, but the coal bill will be largely decreased, and we hope to save a very considerable sum in future by the electrification of the plant."

Theatres and Electric Signalling.

The Manchester Gaiety has been fitted up with a new system of electrical signalling. An automatic switch is connected with the drop curtain, and the fall of the curtain lights a red signal lamp in the offices and in the bars. The manager sitting at his desk knows exactly how the play is proceeding, when the interval is on, how long and also the number of curtains received for each act. The public at the bars are also aware on the disappearance of the red light that the curtain is up.

Shipboard Electricity.

Further particulars of the electrical equipment of the White Star liner Olympic are to hand. There will be four generators of 2,144 h.p., and electricity will not only be used for illuminating the ship when necessary, but for operating lifts, of which there will be two for passengers and eight for baggage and mails; and driving cranes and winches. There will also be 6,300 lamps equal to 100,000 c.p., 60 electric radiators in first-class quarters, 43 electric heaters in the bathrooms, a number of electric fans, electrically-driven spits for roasting, and a large dough-making machine, operated by electricity, capable of making bread for about 3,000 passengers. Furthermore, there will

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be over 100 telephones on board, and upwards of 1,200 electric bells operated from the various cabins, the length of the wire and cables utilised in the electric installation, which will cost something like £65,000, exceeding 200 miles.

Proposed Optical Convention in 1912.

A general meeting of opticians and others interested was held in the rooms of the Chemical Society, Burlington House, on Tuesday, November 29, at 8 p.m., to consider the desirability of making arrangements for the holding of an Optical Convention in 1912. The chair was taken by Dr. R. T. Glazebrook, C.B., F.R.S., as chairman of the Permanent Committee. A resolution was carried *nem con* that, provided sufficient financial support is obtained, an Optical Convention be held in the spring or early summer of 1912. The main objects of such a convention were specified as being (i.) the holding of an exhibition of optical and allied instruments, (ii.) the preparation of a catalogue of optical and allied instruments of British manufacture to serve as a convenient work of reference for all users of optical and scientific instruments, not necessarily to be limited to instruments actually exhibited, (iii.) the holding of meetings for the reading of papers, and for discussions and demonstrations on optical subjects, (iv.) the publication of a volume of "Proceedings," in which these papers would be collected together. The questions of the inclusion of a foreign section, and of the scope of the convention and exhibition were discussed, and an organizing committee was nominated to undertake the work of making the necessary arrangements for the convention.

MAGNETIC PROPERTIES OF IRON AND ITS ALLOYS IN INTENSE FIELDS.*

By Sir Robert A. Hadfield, F.R.S., and Professor B. Hopkinson, F.R.S.

The magnetic properties of materials in fields of very high density are of great scientific interest because the relation between B and H which, in the moderate fields employed in practice, or in the ordinary methods of testing, is so complicated and dependent upon so many variables as to defy analysis, then assumes a very simple form. According to the molecular theory of magnetism, as developed by Ewing, the force which opposes the tendency of the magnetic molecules to set themselves in the direction of an externally applied magnetic force is that due to their mutual magnetic actions upon one another. The system of forces caused by these interactions plays a large part in determining the molecular configuration assumed under moderate magnetic forces, and this system is dependent upon the previous history of the material, on stress, temperature, and on other physical conditions. The molecular theory, while it can give a good account of the general behaviour of the material under moderate forces, clearly forbids us to expect that the magnetic properties under such conditions can be quantitatively expressed in simple terms. On the other hand, it predicts equally clearly that if the externally applied force be so great as completely to swamp the effects of the mutual interactions, the magnetic properties will become very simple. Practically the whole of the magnetic molecules then set themselves in the direction of the magnetising force, without regard to their mutual actions. The relation between B and H becomes—

$$B = H + 4\pi I;$$

where I, in the terms of the theory, is the sum of the magnetic moments of the molecular magnets contained in unit of volume.

If it can be assumed that the moment of a molecular magnet is unaffected by the magnetic forces to which it is subjected, the quantity I, in the above equation, is a constant so far as variations of H are concerned, though it might still be affected by temperature and any other physical conditions which can affect the properties of a separate molecule. The experiments of Ewing and Low* and of Du Bois† show that in iron, nickel and cobalt and some alloys, B does in fact exceed H by a nearly constant amount when H lies between about 2,000 and 25,000 C.G.S. units. These experiments, while they do not negative the possibility of some dependence of the molecular magnetic moment on the external force, give strong grounds for supposing that, at any rate in the materials referred to, the mutual attractions between the molecules are almost completely overpowered by a force of 2,000 C.G.S. units, and that if the force is not more than 25,000 the magnetic moments of the molecules are unaltered by it. The saturation value of $4\pi I$, the constant quantity by which B exceeds H within these limits of the latter quantity is then as definite a physical constant for the material as is the density. Like the density, it may possibly vary with temperature and other physical conditions, but it will probably be unaffected by any change which merely alters the relation of the molecules to one another, and does not alter the internal arrangements of separate molecules. The saturation value of I, expressing as it does the quantity of magnetisable matter in the material, must be regarded as a fundamental magnetisation constant. We propose to call this constant the "magnetism" of the material; or where any confusion can rise with other uses of the word, the "specific magnetism."

It appeared to us that an examination of a series of alloys of iron with carbon and with other metals in fields of very high intensity might lead to results from which some general deductions could be drawn, not only as to magnetic properties, but also as to the constitution of these bodies. The great advantage of the method for this purpose lies in the fact that the saturation value of $4\pi I$ in a material consisting of a mixture of substances, is dependent only upon the relative proportions, and on the magnetic properties of the several constituents separately, and not on their arrangement in the mass.

Most steels consist of such a mixture of constituents, the arrangement of which is an important factor in the results of magnetic testing of the ordinary kind. The arrangement of the constituents as revealed by the microstructure is dependent upon a great variety of circumstances, and this makes it hopeless to look for any simple quantitative relation between the magnetic properties of an alloy as ordinarily tested and its composition. When the alloy is saturated, however, this complication disappears. Let it be supposed that the magnetic moments of the molecules of the several constituents present are respectively μ_1, μ_2, μ_3, and that the numbers of these molecules per unit volume of the material are respectively $n_1, n_2, n_3, \ldots$ Then, if H be above the saturation value, but not so large as to effect μ_1, μ_2, we have—

$$I = n_1, \mu_1 + n_2, \mu_2 + .$$

The same result may be expressed without using the language of the molecular theory if it be supposed that the magnetisms of the several constituents are $I_1\ I_2 \ldots$per unit of mass, and that $m_1\ m_2 \ldots$are the masses of the several constituents present per unit mass of the mixture. In that case—

$$I = m_1 I_1 + m_2 I_2 + \ldots\ldots \quad (1)$$

This relation is not dependent upon any molecular theory of magnetisation, but only on the assumptions that there are definite constituents which are mechanically mixed, and that for each there is a definite saturation value of I.

The material for the research was at hand in the form of a series of alloys prepared at the Hecla works. The alloys have already been the subject of extensive investigation, and many of their physical properties are known. In particular, magnetic tests by the magnetometer method have been carried out on many of them, the force used ranging up to 40 C.G.S.‡ In composition the alloys cover a wide range, including iron-carbon steels, nickel steels, and manganese steels, with varying proportions of the added elements.

Summary of Results.

The following are the most important results obtained from the work so far as it has progressed at present :—

* Abstract of paper read before the Institution of Electrical Engineers.

* *Phil. Trans.*, 1889, A., p. 221.

† *Phil. Mag.*, March and April, 1890.

‡ Barrett, Brown, and Hadfield. *Proceedings of the Institution of Electrical Engineers*, vol. 31 (1901-2), p. 674.

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1. Every alloy examined, without exception, has a definite saturation intensity of magnetisation. In most cases this is reached in a field of 5,000 units, but in a few there is a small increase, as between 5,000 and 25,000. The forms of the curves of magnetisation connecting I and H in these exceptional materials, however, leave no doubt of the existence in them also of a saturation value of I. Every one of the materials tested, without exception, behaves as though it consisted of a mixture of magnetic substances with non-magnetic substances having a permeability not differing materially from unity. This holds good also for the non-magnetic or nearly non-magnetic nickel or manganese alloys, and, in this respect, our results differ from those obtained by Ewing and Low—according to whose experiments a nearly non-magnetic manganese steel had a constant permeability of about 1·4. Among all the alloys which we have tested there is none having a constant permeability differing from unity by more than 2%.

2. There is in the series no alloy having a higher specific magnetism than pure iron.

3. The saturation value of I for pure iron of density 7·80 in absolute units is 1,675 within 1%. This is slightly lower than the values obtained by Ewing and Low and other experimenters.

4. In an annealed iron-carbon steel in which other elements are present in small proportions the specific magnetism is less than that of pure iron by a percentage equal to six times the percentage of carbon. This result constitutes a verification, in the case of annealed iron-carbon alloys of the linear relation (1) above connecting the magnetism of a mixture with the magnetisms of its constituents. In this case there are two constituents, mechanically mixed, viz., pure iron and iron-carbide, the percentage of iron-carbide being 15·5 times that of the carbon in the steel. It is readily deduced from equation (1) that the magnetism of carbide of iron is about two-thirds of that of pure iron.

5. Quenching an iron-carbon alloy from a high temperature reduces the specific magnetism by a large but somewhat uncertain amount.

6. The addition of silicon or aluminium to iron results in a reduction in specific magnetism which is roughly in proportion to the amount added as though the addition behaved as an inert diluent. If carbon be present, however, silicon seems to neutralise its action to some extent. For instance, an alloy containing 2·28 Si and 0·67 C is 3·6% less magnetic than pure iron, whereas if the carbon had its full effect as in iron-carbon alloys, and the silicon were simply an inert diluent the reduction would be 6·3%.

7. The observations on the alloys of iron with nickel and with manganese, or with both these elements, have failed to reveal any simple relation between their magnetism and their composition. It is probable that this is due to the peculiar effects of heat treatment on these substances. When these effects are sufficiently known, it may be possible to apply to the manganese and nickel alloys the same kind of magnetic analysis as we have applied to the carbon steels.

Discussion.

Prof. Silvanus P. Thompson: One could hardly desire a stronger confirmation of the theories put forward by Ewing than was contained in the present paper, viz., that the saturation value of the intrinsic magnetisation is practically a constant. Nothing was said in the tables as to the height the magnetising force was carried, and he wished there was a column which gave the ultimate permeability to which things were reduced. He also could not find the values of μ. One also wanted to know when they had got to that stage whether the permeability had come down so far as z. It was very difficult to understand how that steel could be what it was if it had a constant permeability, and did not, like all other specimens of iron, or steel, have a diminishing permeability in very high fields. He was in a difficulty about one of the specimens, described as white Swedish iron. It appeared to have 3½% of carbonite in it. Was it a cast iron?

The Author: Yes.

Prof. Thompson said that that removed the difficulty. The authors' difficulty respecting quenching was apparently because the specimens used were not sufficiently homogeneous to allow a sound conclusion to be reached. There was talk about Alpha iron, Betta iron and Gamma iron when heated at critical temperatures changing from Alpha to Betta or Gamma, and when quenched in one of those stages changed again to its original form. If that was so, it would surely be capable of being searched out from the other constituents by some method of investigation. It was a most important point that every single specimen of iron or steel behaved magnetically as the sum of its separate constituents and their individual behaviour. Lastly, the author spoke about certain specimens being magnetically hard, apparently because when pushed up into a field of 2,000 they had not become saturated. Did he mean that as a new definition, and was a substance to be called magnetically hard if it did not saturate at less than 2,000?

Mr. J. E. Sears asked whether any experiments had been made with iron nickel compounds containing 36% of nickel, and if so with what results?

Mr. W. H. Mordey said that the paper appealed to metallurgists, chemists and physicists as well as to electrical engineers. With regard to the very important practical qualities of pure iron, it was interesting to find that the paper confirmed the view that iron gave ultimately the highest possible results in magnetisation. Unfortunately, pure iron, or iron very nearly pure, was a very unsatisfactory material indeed to electrical engineers, on account of its want of stability. It altered particularly in hysteresis. One of the most important things one wanted to know about iron was its specific resistance. He thought that there must be hundreds of tons of coal saved every year as the result of using silicon alloys of iron in electrical work. One realised how important physical researches were when it was considered that in a few years results of that kind had come from them. If the author had measured the specific resistances of the numerous materials he should have included them in his tables, as they would have been interesting. It would also have been of interest if the author had given the hysteresis losses of the various materials. He thought that at some future date the author should try to discover an iron, or iron mixture, that would have a very high permeability at a very low density. There was nothing that would be so welcome as an iron that had a high permeability at densities extremely low forces of certainly less than ½–H.

Mr. W. H. Murdock had often wondered whether Ewings' theory could not be tested experimentally. He thought that the ballistic method of testing, where the magnetic field was reversed absolutely so that the flux was changed, was a very unsatisfactory method of testing iron. It seemed to him that the iron being tested under constant forces instead of under constant H, which was what was required in practice.

Mr. Gerald Stoney hoped that the question of alloys would be further pursued so as to get a non-magnetic alloy which could be machined. They had already got stalloy, which had a very low hysteresis and saved thousands of tons of coal; and it would be very important if they could get a non-magnetic steel with some 35 or 40 times the strength and 30% elongation such as could be used for the gaps of high speed armatures and rotors. The author had given them the hint as to how possibly one of the alloys could be made non-magnetic by treatment and then magnetic at any time, and he only hoped that those lines would be pursued.

Prof. J. T. Morris asked whether the saturation density of nickel and cobalt had been determined. That seemed rather an important point, in order to be able to test the iron nickel alloys. It seemed important to get at the value of pure nickel. Many of them had felt that the action of manganese in magnetic forces was most extraordinary, and one had a kind of feeling that manganese would be found to be a magnetic body. It was possible at very low or very high temperatures that it might pass some critical point and become magnetic. It would be worth while testing an alloy like Heusler's magnetic alloy, and as that acted as a magnetic body it made one think that manganese was acting as a magnetic thing. Experiments of that kind might lead to hopeful results. The author had shown them that he was doing further work on the effect of temperature on iron. One wanted to know how it varied with temperature if the value of the saturation intensity reached nil at the critical temperature of 780°. The results

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obtained went to show that the hysteresis loop ought to go up to a certain fixed value and should not go beyond.

Mr. T. H. CHURTON asked whether any investigations had been made in the molecular structure of the specimens which had been subjected to high magnetism a number of times, and to reversals. What suggested the question to his mind was that on two or three occasions he had known some armature teeth that had been subjected to very high flux to have broken off and come out, fowling the armature after being run under such conditions for a comparatively short time.

Mr. W. H. PATCHELL said that on that point during the fire at Maiden-lane the battery short circuited. They tried all ways to use the copper rods again, but they had gone rotten by the heavy current flowing through them. By annealing, however, they were able to use them again.

Prof. B. HOPKINSON (in reply) said that with very few exceptions the pieces had been tested up to a maximum of 23,000 C.G.S. units. There were a few which had been taken up to 14,000 or 15,000 by the differential method, which did not admit of quite such high inductions. Single pieces had been tested up to saturation and H taken to 25,000 in the majority of cases. In reply to Prof. Thompson, the permeability worked out at very nearly two or less. Prof. Thompson had made some interesting remarks about the permeability of manganese steel. It troubled him, the author, a good deal in the course of his researches that he did not find a body which had a nearly constant permeability to the order of 1·3 or 1·4. Prof. Thompson said he was troubled because there was such a body. The actual permeability of the manganese steel that he experimented with did not differ from unity by more than 1%. Ewing's result with that same steel was more difficult to explain, but there was a footnote in the paper dealing with it. As regards the effect of quenching and the possible sorting out of Alpha, Betta and Gamma iron, he hoped it might be possible in the future to learn something about them, but at the present it was better to say nothing about them. The turn " magnetic hardness " was a phrase used by Barratt in the joint paper read before the Institution some years ago, and he, the author, had used it in the same sense. He did not attach any definite numerical meaning to it. He assumed that when Mr. Mardey said that pure iron was a most unsatisfactory material because of its want of permanence, he was referring to the changes it would undergo. That was true in the ordinary fields employed in the usual methods of testing, but it ceased to be true when the induction was pushed to very high values. He did not make any measurements on hysteresis losses. There was something in the view that the ballistic method of testing was unsatisfactory when low fields were considered, but it did not effect the material very much in high fields when the matter became saturated. The interest of Mr. Stoney's remarks to the author was that they suggested the possibility of using that method of research as a means of investigating the constituents of steels and so producing new steels. The effect of raising the temperature was to reduce the saturation value of the intensity of magnetisation. The reduction began from the beginning, and went on until the critical point of 750° C. was reached, when it disappeared altogether.

INDIAN RAILWAYS AND ELECTRIC SIGNALLING.

The provision of lock and block instruments for working the avoiding lines between the Asansol and Raneegunge stations, East Indian Railway, has, according to *Indian Engineering*, recently been completed. On December 31, 1909, this line had 310 stations out of 429 stations at which the points and signals were interlocked. Of these, 149 stations were interlocked on the English railway system, while 160 stations were interlocked on Dutton's system, an invention of Mr. S. T. Dutton, signal engineer to the East Indian Railway. One station was interlocked experimentally. Block instruments for train signalling were in use at 344 stations, namely, Price and Ferreira's, in which a token is not necessary, at 61 stations; Neale's patent voucher at 127 stations; Tyer's tablet instruments at 14 stations; E. I. R. tablet instruments at 32 stations; and E. I. R. double line block instruments at 110 stations.

WHAT'S WRONG WITH THE ELECTRICAL INDUSTRY?

By H. Ambrose Carney.

DISCUSSION.

Mr. A. B. ANDERSON (Chairman), opening the discussion, said he agreed with the general statements in the paper, but he did not think the root cause of the prevailing unsatisfactory condition of the English electrical industry, as compared with the electrical industries of other countries, had been stated. This he considered to be the English system of free imports. The British capitalist was without peer in the whole world, and when huge sums of money were wanted, other nations came to England to borrow them. But before money could be obtained some security was required for it, and the better the security the lower the rate of interest. The financiers refused absolutely to advance money against patents, and the patenting of a new invention was usually the first step in its development. This meant, then, that new ideas must be developed and made commercial by engineers themselves before capitalists would help. But at present engineers had no money. The first thing that the cautious industrial investor looked to was the size and security of the markets, for the prospects of profits depended very largely on the size of the works which could be kept fully occupied, since this meant the minimum percentage of standing charges. The English electrical industry had not a single secure market, and, consequently, had nothing to offer the average industrial investor who had no inside knowledge of the business. For the same reason, the speculator on the look out for large returns could not be induced to develop new ideas. In both Germany and the States, a steady market was assured to home manufacturers and money was, consequently, readily obtainable because of the protection of tariffs. Nothing but protection would improve the condition of the English industry. The electrical industry in this country was struggling along under conditions which none of the staple industries experienced. No new English industry had been really developed under Free Trade. This was an age of organisation, and they would do no good by simply banding themselves together; they must amalgamate; but, again, they cannot, because they have no market secured. It was truly said " money made money." Money was not in the making in this country as was necessary for continued growth. A business or undertaking was not necessarily badly managed because its technical officers were supervised by commercial men, but often the reverse. The English textile export trade could not be compared to the electrical export business; it was almost entirely in the hands of foreigners. The American and German firms did not come over here because of saving carriage costs, but in at least one case because they believed a protective tariff would shortly be introduced here, and they wanted a share of the spoils. He did not agree that British electrical engineers had it entirely in their own hands to make the English electrical industry the electrical industry of the world; they could supply everything but the one necessary thing—money.

Mr. R. G. CUNLIFFE, M.Sc.Tech., thought it was not fair to condemn the capitalist as unenterprising until the proposed schemes had been properly put before him. He wanted to know why the British capitalist had been singled out for comment. One of the reasons why the British people had not secured the advantage of British brains, was because education in this country was usually of a lower standard than in Germany. They found both in Germany and the States that the control of the various industries was in the hands of huge trusts, and apparently in no other way could prosperity be assured.

Mr. BRYDEN considered that the great reason for the unsatisfactory condition of the electrical industry in this country was the fact that until just lately all English manufacturers had been sitting down, believing that having led for so many years, they would always lead without effort. Formerly they were content, for instance, to do their foreign trade through agents who rarely understood their business, but now, under the necessity of foreign competition, they were beginning to send out properly trained men, with the result that the English electrical export business was rapidly increasing, for it was found

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that having the same amount of information to work on, the English firms were quite as able to put forward satisfactory schemes and prices as their competitors were. He thought that the indirect effect of labour troubles was a minor cause, inasmuch as it upset the business of other trades to which the electrical industry looked for an outlet for its material.

Mr. D. HARROP pointed out the difference in effect between protection here and abroad. If protection raised home costs—granted the limited field of England—then it would not help the export business, but hamper it by raising foreign selling prices abroad. It was impossible for a man who did not know what he was talking about to successfully sell electrical apparatus in competition with the man who did.

Mr. CROWCROFT disagreed with the "make everything" type of firm, and thought greater specialisation was possible. Supply engineers were, in his experience, very lackadazical, and this applied nearly as much to the officials of supply companies as to those of municipal undertakings. He considered the stringent Board of Trade regulations as to the use of overhead lines was a very important factor in the backwardness of electricity supply in country areas. He did not see that protection was quite a necessary preliminary to agreements as to price-cutting, etc. The Cable-makers Association seem to do very well. Why could not other branches of the electrical business form rings here?

Mr. J. S. MESSENT expected full working drawings, showing how to put the industry right and what the screws would be, and thought the suggestions given were mere platitudes. The paper was more of an address to shareholders than to students. He wanted to know where the technical men would benefit? The proposal of protection would force on the industry at the expense of the country. He thought natural factors really made the difference; overhead wires were practically prohibited, and there was no great amount of water power available as abroad.

Mr. A. R. STELLING, Dip. Ing., disagreed with the reason advanced for bad trade—that there was not enough work to go round—if it was applied to the trade in general, it was correct for the home trade. That being so, we had to concentrate our attention on foreign trade to fill up the gaps in the home trade. The electrical industry depended entirely on the other industries of the country, and rose and fell with them. To help the electrical industry the other industries must be helped. He mentioned the fact that even the manufacturers of textile machinery were recently on half-time, and that one old-established firm who had never before been slack had fared no better than the rest. How could the English electrical industry be expected to be healthy when the staple trades even were failing? They would be improved eventually, but how was the electrical industry to keep going in the meantime? Only by the development of the foreign markets. His advice was do not cut prices in the home market, but go abroad for orders. The natural resources of England were greater than those of America or Germany. For instance, coal was rather scarce in many parts of Germany, and so electricity was there cheaper than gas. This all affected the relative volumes of the home trades in the different countries.

Mr. GREEN thought British foreign trade in general had suffered considerably as the result of being done through ordinary commission agents and not by proper representatives.

Mr. WILLIAMS suggested that there were more ways than one of protecting an industry. It might, for instance, be done by means of Government subsidies to assist in cheap production, the subsidies being ultimately repaid when the industry was established. As examples of trades established in England under Free Trade, he mentioned the cycle trade and the motor car industry. Electricity was at a disadvantage in England, because it was all along met by some other agents, steam and gas, which it had to oust, whereas steam power was such a tremendous advance over manual labour, and gas light over lamps and candles, that they quickly took the field. He thought British "conservatism" was largely responsible for the troubles of the electrical industry. Apathy was not only a cause, it was a result. The metallic filament lamps had hit the manufacturers just as hard as the stations. The pushing of lamp load would simply mean large peak loads. He thought greater development would take place by reducing the price of electricity: this would immediately tap a market. Mr. E. W. Cowan had discussed this fully recently.

Mr. Arthur Welch writes:—

"Being prevented by business reasons from attending either of the two meetings of the students' section in connection with Mr. Carney's paper, I am taking the liberty of forwarding a contribution to the discussion.

"Mr. Carney's paper is to be welcomed as a courageous attempt to deal with a question which is, and will continue to be, of supreme importance to all connected with the industry.

"That the state of the industry is unsatisfactory cannot well be denied, and one is inclined to think that only by concerted action can this state of affairs be remedied.

"The manufacturer's complaint is that the work which is at present obtainable does not produce a fair margin of profit. Obviously, there are two methods of overcoming this difficulty. Either higher prices must be charged for the goods or more goods must be sold. An increase in price would be bound to further restrict output and would react to the disadvantage of the industry. On the other hand, it is universally recognised that the old expression, 'Small profits—quick returns,' is a valuable one in all commercial enterprise from the sale of pins upwards, and it is the foundation upon which most successful business ventures have been built up.

"In his last paragraph the author has pointed out four main lines upon which he thinks efforts should be concentrated. It would appear that his second point (*i.e.*, to force as rapidly as possible the universal use of electricity) is the important one. The education of the customer through technical salesmen (his fourth point) is only one of the means to this end, whilst his other two points will follow as natural results of its attainment.

"It is only fair to admit that many manufacturers are recognising the utility of a publicity campaign, in the incandescent lamp department, at least, and it is a sign of the times that on the public hoardings beautiful pictures of electric lamps are now to be seen where only a few years ago the incandescent gas mantle advertisement shone supreme (and alone). But one is tempted to ask why is this energy restricted to lamps?

"Attempts should be made, particularly, to stimulate the use of electric fans, radiators, domestic appliances, electric automobiles, and day-load generally, which would improve the load factor of power stations, and by thus reducing costs react towards that cheapening of supply which is essential to the attainment of the ultimate ideal of electricity in every home.

"But beyond doubt the best weapon in the hands of the seeker after business is a good, cheap article, and therefore the provision of this is the fundamental objective to be kept in view. Specialisation by manufacturers, as the author says, would help greatly in this direction, especially if supplemented by improvements in design as the result of the establishment of experimental departments by large firms and the further encouragement of technical education among staffs.

"The general trend of the author's opinions appear correct, and particularly is he right in deprecating the attribution of the industry's weakness to our system of free imports. Any industry which needs protecting has something wrong internally, and in this age of the survival of the fittest, it is more important that electrical engineers shall be engaged in legitimate endeavours to put things right than in clamouring for legislation which *might* enable them to boost up the industry temporarily at the expense of the remainder of the community."

Mr. H. A. CARNEY (in reply) pointed out that Tariff Reform, however necessary it might be as a means of improving the electrical industry, was a subject which the Council had barred in institute debates. He quite agreed with Mr. Anderson that the capitalist was not really to blame for not financing the electrical industry and new ideas, but he thought the general body of engineers entirely responsible for not encouraging the capitalists to do so and combining to point out to them the great value of the various epoch-making schemes which had been proposed by British engineers. Granting for the moment that the

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English market was not secure to a new idea, the British capitalist could still command the markets of the world; why did he not reap the advantage of developing it abroad in a second market—say, in Germany—instead of leaving it to the foreigner altogether? Or again, suppose that the capitalist had developed the scheme in England, he had it in his power by the granting of licences under foreign patents and by taking a controlling interest in their foreign development to protect his home field from competition to a very large extent. The argument of insecure markets was thus disposed of. It all came back to the one point, that the British capitalist had not been made to appreciate the possibilities of the original schemes, because engineers themselves did not appreciate them. This was a root cause which could be prevented now and in the future by watchfulness on the part of engineers and their general support of all proposals of merit. But how to remedy past mistakes and put the industry right? Dumping could be met only by the ability to dump; by increasing the output in order to reduce the standing charges to the minimum. Combinations and amalgamations had been suggested; they were suggested years ago, and apparently they were as far off as ever, for there still existed the old trouble of a mutual and respectful distrust among manufacturers. Where combination was impossible, individual effort must be tried, and he had written his paper from the point of view of the "cumulative effect of individual effort." His remedy was that each firm must adopt the tried and trusty principle of "branding," that was, the establishment of some speciality and its development as the main business. Each firm would have to strike a line for itself and make the wanted article which the other man did not make, instead of rushing in to make that which he did. They would thus be doing something not only to improve their own trade, but at the same time reducing instead of increasing the amount of competition, and owing to such of the firms as did compete in the same line, each getting a larger share of the available orders than at present, production would be cheaper and consequently lower prices to the consumer—inducing further business and lessening the competitive value of dumped goods—more competible with a profit; while as a result of there being fewer firms in direct competition, working arrangements for preventing excessive price-cutting would be much easier to bring about than they were at present, with all the hundreds of small and large firms competing in the same markets. In reply to Mr. Cunliffe, the British capitalist was specially connected, or ought to be, with the British industries. He agreed that the greater technical education of engineers abroad was a factor to be considered. In the light in which Mr. Bryden looked at the matter, labour troubles probably had some indirect effect on the volume of electrical business, but he thought it was very small. He agreed with Mr. Harrop that, seeing the importance of the export trade, it would be unwise to damage its chances in any way. With regard to Mr. Crowcroft's remark about Board of Trade restrictions on overhead wires, he thought the trouble was more with the local Urban District Councils, who had power to veto any such schemes; and with the cost of wayleaves. With a greater demand for overhead lines, Board of Trade restrictions would gradually be removed. Mr. Messent was under the impression that power was dearer here because there were no waterfalls, but actually the cheapest electrical power in the world was produced in the Newcastle district by the help of blast furnace gas, and there was no reason why this should not be more widely used, beyond the apathy of British engineers. He thought the interests of shareholders and engineers identical; "rises" were not obtained when dividends were falling. Mr. Stelling was correct in his interpretation of his remarks as to bad trade. Just because the electrical industry was so closely dependent on all others, he thought it should not be assisted by any means which might eventually injure those industries, for that would mean the ultimate injury of the electrical industry. Trade was now booming, and the electrical industry's time was at hand; that was why he put forward his paper, because it was easier to get on the right lines in prosperous times than at any other time, and success was only maintained by the careful planning for possible reverses. Mr. Stelling mentioned that Germany and America were naturally better adapted for electricity than England; they had also a much greater area and greater capacity for extension than this country. Mr. Hunt's suggestion of the the use of subsidies was being carried out in connection with the manufacture of carbon and telephones.

I have to thank Mr. Welch for his communication to the discussion, and am glad to note that he agrees with my general treatment of the subject. My opinion is that manufacturers must make up their minds to put up with low prices, paying their dividends by doing more output on the same capital and expenses. This can very easily be done if the problem is tackled seriously. I am particularly pleased that Mr. Welch agrees with me as to the necessity of forcing on the supply of electricity for all purposes. Perhaps when I have formulated my scheme of assisting this step, by the combined effort of manufacturers, contractors and all workers engaged in the electrical industry, I may count on Mr. Welch's hearty co-operation in making it a practical success. It is of paramount importance, as Mr. Welch says, to have good, cheap apparatus, but the cheapness must be secondary to the goodness. Cheapness can only come as the result of quantity. One of the most striking natural features of specialisation in manufacture is, and will be, the perfecting in design, the improving of quality, and the cheapening of production, which manufacturers are at present trying to obtain. With the specialist firm there will be little need for special and expensive experiment departments; improvements will be gradually evolving themselves every day in both shops and offices, as the natural result of the management's singleness of purpose—the making of one type of material, better than any other firm can make it.

Mr. Welch's last sentence exactly expresses my view on the agitation among electrical engineers against the system of free imports.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways, and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

QUESTIONS.

Question No. 1238.—State the real advantages to be gained by using direct current for overhead cranes in a bridge-building yard already possessing an unlimited supply of alternating current; three-phase, 400 volts, 50 v. —"STUDENT."

ANSWERS.

Question No. 1235.—State the main points to be taken care of in laying out hydro-electric schemes. When is it necessary and when economical to instal auxiliary steam plant? What considerations govern the choice of towers, the permissible line drop and the working frequency? What is current voltage practice in such schemes and how may voltage be raised later on if desired? How are the sub-station positions and ratios of transformation determined?

Answer to Question No. 1235 (*awarded* 10s.).—The first two considerations to be dealt with in planning a hydro-electric transmission are: the availability of sufficient power in sufficiently constant quantity throughout the year, and a good market for the energy within reasonable distance of the waterfalls. These two conditions being satisfied, and the probable capital cost being moderate, the scheme should be commercially feasible. As accurate records, as are available, of the flow of the stream during the past three to six years should be carefully studied. In some cases it is necessary to act upon an accurate knowledge of only one year's flow, the extent to which this is representative being judged from more or less reliable local

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reports and records: such a procedure is usually very risky. Having thus determined upon the probable hydraulic power available, it is necessary to study the present and future competition to be contended with. This competition includes not only existing and prospective hydro-electric schemes, but also the existence or possibility of coal generating stations and the possibility of the discovery of coal fields near the proposed market. (Thus it was the probability of new coal fields being discovered near Johannesburg which so heavily handicapped the proposed Victoria Falls power scheme.) Though it should not be so, we find that a power company which has or may have to compete with other sources of power supply, is far more cautious and economical in installation and operation than one which enjoys a monopoly.

A "good" market for hydro-electric power may be defined as a group of large power users (some present, some potential), willing and able—without serious dislocation of their business—to convert their plant to electric driving: the group must be within a reasonable distance (dependent upon the line voltage and the total kilowatts to be transmitted) and not too scattered (or an excessive amount of distributing plant and cables will be required); scattering along the line of transmission is naturally preferable to any other. Future extensions of the market should be estimated and allowed for according to the period which will probably elapse before their realisation. Great discretion is needed in determining whether certain parts of the installation should be given their ultimate capacity in the first place or replaced after a few years, when possibly reduced prices and improved forms of the equipment in question will, together with the lower capital charges meanwhile, more than compensate for the cost of the temporary plant and its subsequent conversion.

Whenever possible, early contracts should be completed with prospective consumers in order to determine where and in what amounts power will be saleable: the general lay-out of the scheme can then be arranged accordingly.

Auxiliary Plant.—Where the "low-water" or "dry season" flow of a stream is considerably less than the average flow during eight or ten months of the year, it is usually wise to instal auxiliary steam plant particularly if more than the average low-water output of the stream or falls can be easily disposed of. In some cases the demand, at present and in the immediate future, is considerably less than the minimum output of the stream, and auxiliary steam plant is then unnecessary. The capacity of the auxiliary plant may be such as will simply enable the maintenance of normal total output from the station during the driest season (the "secondary" plant being then practically idle during many months of the year), or the auxiliary equipment may be of considerably greater capacity (say, 30–50% of the hydraulic capacity), and may be run all the year round. It will still be fully loaded, mainly during the "drought" period, but during the remaining months the output of the station may be increased (so as to utilise the steam plant more fully) by offering the surplus capacity of the station at reduced rates, such as will induce power users, having their own generating plant, to purchase from the supply company during six or eight months of the year, then running their own installation only during the dry season. Where coal is dear at the hydraulic station the auxiliary equipment should be of minimum capacity, but under favourable conditions such as the above a larger secondary plant will be economically satisfactory to both company and consumers. The shorter and more intense the drought period the more serious will be the loss of station output following the non-provision of auxiliary plant, while, on the other hand, the greater will be the difficulty in obtaining economical working for the secondary installation during the remaining months of the year. In any case, auxiliary steam plant forms a valuable safeguard against breakdown, and obviates the necessity for stand-by hydraulic equipment.

Voltage.—Where reliability of supply is of vital importance (as is more generally the case in average manufacturing districts than in mining areas), it is wise to be somewhat conservative in the choice of a working voltage. In such instances, 40,000–60,000 volts forms a desirable upper limit of pressure. The higher the voltage the lower the line cost for a given efficiency or the higher the efficiency for a given copper section, but, on the other hand, the greater the liability to breakdown, and the more costly the generators, transformers, switchgear, insulators and sub-stations.

It is frequently desirable to commence supply at a lower pressure than that ultimately mooted: the insulation of generators, transformers, line, switchgear, etc., should then be designed for the ultimate voltage, and, by running transformer windings in parallel, later to be changed to series connection, a 2 : 1 rise in voltage may be provided for, or by adopting delta connections in the first place and later changing to star connections, a $\sqrt{3}$: 1 increase may be secured.

The more or less arbitrary selection of line voltages in the past has gradually evolved the more or less standard series of pressures—6·6, 11, 22, 33, 44, 66, 88, 110 and 165 kilovolts, 100,000–110,000 volts is, at present, the upper limit of pressure generally considered advisable, but 60,000–80,000 volts, working pressures only made possible during the last 10 or 20 years, have now become almost commonplace.

Frequency.—For large power motors, and particularly for traction motors, a frequency of 25 cycles is desirable, but for lighting and general purposes a higher frequency (say, 50–60 cycles) is preferable. The power factor of such a high frequency system is better (owing to the leading charging current), and this tends to reduce the copper cost of the line; the higher frequency, however, generally results in a net increase in the line losses. If there be a considerable rotary convertor load, low frequency supply is highly advisable. Low frequency (25 ~) machinery and equipment is usually some 10–25% dearer than that for 50–60 ~ systems.

If, however, electrical energy is already in use in the area to be supplied, the proposed scheme must adopt the already existing frequency, unless—

(1) The new rates of supply will be so low as to induce consumers to replace their motors by those of the new frequency;

or (2) The fresh company is prepared to

(a) Finance the conversion;

or (b) Lose the present electrical load until such time as the consumer cease to convert;

or (c) Instal motor convertors (costly, if there are many distributing points);

or (d) Instal separate lines supplying the old frequency on one system and the preferred frequency on the other.

Line, Poles, etc.—A small upper section in the transmission line necessitates high working pressure to secure a given efficiency, and involves the use of a large number of poles to reduce the sag per span to a permissible amount (thus No. 0 B.S. is the smallest wire permissible for 500 ft. span). On the other hand, a heavy line requires more massive poles or towers, and *is itself very costly.*

For single-line routes carrying moderately light wires, creosoted wooden poles are usually preferable to lattice towers, but on very important routes, where duplicate lines have to be carried, and for heavy wires and long spans, steel lattice towers, scientifically designed, are cheaper and more satisfactory. The life of a lattice tower is at least twice that of a wooden pole, and, in those cases where the metal structures are most desirable, their capital cost is little if any greater than that of equivalent wooden supports. In some cases a certain liability of breakdown is preferable to the heavy capital cost of a duplicate line, and in all cases liberality in the matter of insulators is amply repaid by the increased security of working. In at least one great power scheme, involving the transmission of close on 250,000 kw., 60,000 volt insulators were used for a working pressure of 44,000 volts, the results justified the means.

The most economical line drop and loss must be determined in every instance by reference to the line voltage, the kilowatts transmitted, the normal power factor of the system, and the cost of copper (at the time of installation), and the estimated cost of the power supplied. Thus, in the case of the Southern Power Company's Great Falls to Catawba line, transmitting 20,000 kw. at 44,000 volts and 0·85 power factor (copper 10d. per lb., energy £1 per kilowatt year) the line drop was 13½% and the loss 7¼%.

Sub-stations.—The number of sub-stations required by a line transmitting a certain amount of power depends

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upon the distribution of the various groups of consumers and the low tension pressure required. Where 500–600 volt is required (as in many factories, particularly those employing motors of less than 30–50 h.p.) many sub-stations are necessary for economical distribution, and for this reason it is advisable—unless whole communities can be supplied for lighting and miscellaneous power purposes—to distribute from sub-stations at 2,000–2,200 volts (in which case each sub-station can efficiently feed an area of about two miles radius) using 2,000 volt motors where possible, and in other cases stepping down from 2,000–500 volts at the various works themselves. The cost of the local transformers and of the higher insulation on the 2,000 volt circuits if offset by the lighter copper section of the latter and by the cheaper rates at which the company can supply energy under this arrangement. Small sub-stations supplying individual works may well be owned by the consumer, but should be installed by the supply company, standard equipment conducing to economical upkeep and ready substitutions in case of breakdown. If attendants are required in the sub-station, the load is sufficiently large and important to justify complete management by the supply company.

The capacity per sub-station varies with the demand of the various consumers and the area over which the latter are spread, but in a certain American scheme supplying scattered textile mills the

Capacity of the old 11,000 volt sub-stations varied from 300–1,500 kw. per station; in 100–500 kw. units the mean capacity being 475 kw. per station in 160 kw. units.

While the new 44,000 volt sub-stations varied from 300–3,000 kw. per station in 100–1,000 kw. units, the mean capacity being 1,220 kw. per station in 410 kw. units.

It may be taken that, in new sub-stations, no smaller than 300 kw. transformers should be installed, while 500 kw. is a more desirable minimum, particularly where extensions within the next few years would probably necessitate the latter in any case.—"TAP."

ELECTRICAL IRON TESTING.*

By D. Cue.

The chief use of iron in electrical machinery and apparatus is as a magnet, and this paper is concerned almost entirely with the magnetic properties of iron, its use as a resistance being only lightly touched upon.

General principles of magnetism—explanation of terms used. Requirements of iron testing: (a) Research to investigate the properties of iron. (b) Every-day commercial tests to ensure that the iron used is of sufficiently good quality.

Methods of iron testing, for permeability—

(1) Inductive or ballistic method.
(2) Traction method.
(3) Magnetometer method.
(4) Bismuth spiral in air-gap.
(5) A special instrument whose principle resembles both (2) and (3).

For Hysteresis—

(1) By a magnetic cycle (hysteresis loop).
(2) By Ewing tester.

For total loss (eddy current and hysteresis)—

By Wattmeter method.

Details of methods used. Their advantages and faults. Size and form of the sample—(1) Ring, (2) long bar, (3) short bar in yoke. Method of winding. Arrangement of test set. Special instruments. Holden iron tester (two forms). Drysdale plug. Hopkinson divided bar. Permeameter. Ewing magnetic curve tracer. Ewing hysteresis tester. Form of deflectional instrument suggested by author. Criticisms of these instruments.

Consideration of results.

B.H. curves for cast iron, sheet steel, stalloy and dynamo cast steel (obtained by the author).

Magnetic properties of other metals—magnetic alloys of non-magnetic materials and non-magnetic alloys of magnetic materials.

Effect of temperature, longitudinal stress, composition, hardness and direction of grain upon permeability and hysteresis. The application of these results to practice.

Hysteresis, typical loops for (1) high and low induction, (2) hard and soft material; relation between hysteresis loss and flux density (obtained by the author). Proportional to $B^{1.6}$ approximately.

Eddy currents—for good quality iron, loss is small compared with hysteresis, and depends more on other variables than on the hardness of material.

Results of research show that for ordinary tests it is sufficient to take a simple B H curve and the hysteresis loss for one value of B, but it is also advisable (where practicable) to measure the specific resistance which is a very good indication of the hardness and composition.

Use of iron as a resistance. (1) Wrought iron wire, (2) cast iron grids. Wire is used for moderate currents, either wound (bare) on asbestos tubes as in the Adams and similar rheostats, or woven with asbestos string into a mat. High resistance alloys, such as Eureka, are, however, replacing iron for wire rheostats.

Cast iron grids, however, are largely used for heavy currents, as in traction work. Resistance is not very constant; 20% variation is allowed on whole grids, and the specific resistance sometimes varies as much as this also. The normal value is about 120 to 130 microhms per cm. cube. Nickel is added sometimes, but whether for electrical or mechanical reasons the author is not aware.

With each batch of grids, two test bars are cast, which are turned down to ½ in. by 10 in. and tested for specific resistance. Resistance taken by drop method. About 40 amps. passed through the bar and drop on 20 cms. measured by millivoltmeter. Temperature co-efficient of cast iron.

* Abstract of a paper read before the Northampton Institute Engineering Society, on Friday, Dec. 16. Mr. H. M. Hobart in the chair.

PHYSICAL SOCIETY'S EXHIBITION.

The Physical Society's annual exhibition, which is to be held on Tuesday, the 20th inst., will be open in both the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). Prof. J. A. Fleming, F.R.S., will give a discourse at 4.15 and again at 8 p.m., on "Some Improvements in Transmitters and Receivers for Wireless Telegraphy"; and Mr. R. W. Paul will give a number of cinematograph demonstrations of some "Physical Phenomena." The following firms will be exhibiting:—R. and J. Beck, Ltd.; British Radio-Telegraph and Telephone Company, Ltd.; Cambridge Scientific Instrument Company; Casella & Company; A. C. Cossor, Ltd.; H. W. Cox & Company, Ltd.; Crompton & Company, Ltd.; J. H. Dallmeyer, Ltd.; Elliott Bros.; Everett, Edgcumbe & Company; Gallenkamp & Company; Gambrell Bros.; J. J. Griffin & Sons; Hicks & Company; A. Hilger, Ltd.; India Rubber, Gutta Percha, and Telegraph Works, Ltd.; Marconi's Wireless Telegraph Company; Leslie Miller; Muirhead & Company; Nalder Bros. & Thompson; Negretti & Zambra; Newton & Company; R. W. Paul; W. G. Pye & Company; Strange & Graham; H. Tinsley; Townson & Mercer; Weston Electrical Instrument Company; Wright & Company; Carl Zeiss. We understand that invitations have been given to the Institution of Electrical Engineers, the Faraday Society, the Optical Society, and the Röngten Society. Admission in all cases will be by ticket only, and therefore members of the societies just mentioned (including also the Physical Society) desiring to attend the exhibition should apply to the Secretary of the Society to which they belong.

LONDON ELECTRICAL ENGINEERS.

About 10 officers and 200 men of the London Electrical Engineers Territorial Force, under the command of Major A. E. Le Rossignol, proceeded to Sheerness on Saturday last for week-end training. The work undertaken was the same as the Corps would have to do in war time, and consisted in running the defence electric lights from dusk to dawn. Everything was done under mobilization conditions and the men who were not actually on duty rested in the war shelters. The detachment returned to London on Sunday.

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Secretaries and Managers of Companies are asked to furnish Notices of Meetings, Issues of New Shares, Installations, Contracts, and any information connected with Electrical Engineering which may be interesting to our readers.

Inventors are informed that any account of their inventions submitted to us will receive our best consideration.

Contractors can make use of our columns to obtain the names of the makers of any specialities they require in their business.

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METALLIC FILAMENT PROBLEMS.

No doubt even yet the most obtrusive problem connected with the metallic filament lamp is its depressing effect on the market for current for illuminating purposes. That aspect of the case, however, is fast adjusting itself, the usual economic law that lowering of cost brings about increased demand coming into operation. We are thus able to recognise the metallic filament lamp as a very real progressive step in the electrical industry. But this makes it all the more imperative that such lamps should be as near perfect efficiency as possible. Actual experience proves that our manufacturers have effectively met the various difficulties cropping up, and shown marked enterprise in improving the lamps along different lines. They are certainly much less fragile than they used to be, in spite of reduction in cost. Other questions await solution. One of these was touched upon in a very interesting paper read by Professor G. W. O. Howe before the Illuminating Engineering Society last Friday. He discussed the phenomena of the blackening of tungsten lamps, basing his remarks on observations made on three pairs of globular 110 watt lamps, which had done good service on a 200 volt circuit for upwards of 1,500 hours, then taking 100 watts and giving 36 mean horizontal c.p. Soon after the 1,500 hours stage was reached one of the lamps failed, the filament breaking off near the leading-in wire, and although repeatedly mended by bringing the filament in contact with the end of the leading-in wire, the mending was a makeshift. Nevertheless, the results obtained as above were excellent. The ground for complaint was that after the lamps had been running for some time it was observed that the bulbs blackened towards the tops, under the caps. It was seen that this was caused by a brilliant copper coloured deposit, and after careful examination Professor Howe found that the blackening had been caused by particles projected from the joint where the filament was

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connected with the leading-in wires. It was at this point, too, that failures arose. But the "blackening," which is really the copper deposit acting as a mirror, reflecting all the external light falling upon it, was not due to arcing after breakage, for the copper deposit is very noticeable in unbroken lamps. Professor Howe so far has not been able to ascertain whether both the positive and negative joints are effective in blackening. An extremely curious point is that this bombarding by coppery particles is only observed in the round globes, and not at all in the pear-shaped globes; yet both kinds of lamps are said to be manufactured exactly in the same way. For the present it is held that the coppery particles come from the leading-in wires, which contain a certain amount of copper, and Professor Howe suggests that the difficulty may be overcome by excluding copper from the joints. This, he thinks, would reduce blackening, and at the same time the probability of breaking. This problem of blackening is in itself very interesting, but it may lead to even more important investigations. By the study of these phenomena, and with substitution of various alloys in the joints, may we not arrive at some juster idea of the causes underlying failures and breakages? It is a line of research well worth following up.

CORRESPONDENCE.

All communications intended for the Editor should be addressed "THE EDITOR, 149, Fleet Street, London, E.C." Anonymous communications will not be noticed. Letters should reach the Editor not later than Tuesday afternoon to be included in that week's issue of the Journal.

The Editor is not responsible for, nor does he necessarily endorse opinions advanced by correspondents.

THE COMMERCIAL OR TRADES ENGINEER.

Sir,—In my opinion Mr. Carney's paper ranks very high amongst those ever presented before the Institution of Electrical Engineers. There is no catalogue matter or spidery algebra; no columns of test data done by badly-paid "laboratory ghosts." Further the paper is at the opposite pole to that read last session which blatantly puffed one make of brake at the expense of another.

Every sentence Mr. Carney has written is as original as it is weighty; he hits out straight and hard. For example, he has no use whatever for the usual type of men who are on the electricity committees of municipal electric supply undertakings. He says: "The supervision of a trained electrical engineer on the management of his department by a small body of untrained men, in the great majority of cases incompetent or helplessly ignorant of even the elementary principles and economics of electricity supply, is ridiculous and is a condition of affairs only possible under municipal control."

One might almost say "only possible in England." The farce of having electricity supply, which of all other business requires the most expert and most up-to-date knowledge, managed by shopkeepers who have got into their position by the gift of the gab and the support of one or other of the political organisations, is ludicrous in the extreme.

Public utilities as electricity, water and gas supply and the means of transport as they are called in America require experts. Their management by commissions of paid experts, as in America and in some parts of Australia, is miles ahead of our present ridiculous municipal control.

But the part of Mr. Carney's paper which I like best is where he refers to commercial ability in the electrical industry. He says, quite truly, that "The customer's dealings are at present with men who are merely ordinary salesmen, all right for selling a non-technical commodity, but quite unable to clearly understand and point out to him just exactly where their design surpasses all others, and why it does. Of what use is the perfecting of designs if the salesman is not able to convince the customer of their excellencies?" At one time the writer had to interview a large number of men who came round to push their goods. He became so convinced of the waste of time seeing the non-technical salesmen that he made it a rule to only interview those who could show membership of one or other of the engineering institutions.

The trader engineer who has a good thing to sell is worth talking with at any time, but the ordinary salesman who has only cheek and bluff is a nuisance. Indeed, he is worse, for he is probably keeping some young engineer out of a job.

Mr. Carney says: "The greatest thing, however, and one which can do more by itself than any other single means, is the production and use at the very earliest moment of thoroughly commercially-trained engineers and of thoroughly technically and practically-trained commercial men as salesmen."

That is the keystone of the whole matter. Our firms can produce better goods than foreign firms, and in many cases at lower prices. I speak of that which I know at first hand, because I have had dealings with foreign firms. Besides, those international concerns which have works in America, Germany, France and Great Britain are finding that the articles they make, such for example as machine tools, can be produced cheaper here, than at any of their other works, and that in spite of harder cast-iron and steel being employed.

Why then do we not take the lead in selling the goods? The answer is, because of our lack of trader engineers. The ideal set up in the engineering profession of the country is that only the technical side is worth considering—the commercial side is *infra dig.* This is largely because our institutions are controlled so much from the academic side.

It is high time that matters were altered, and it will be found that Mr. Carney, although only a student, has made a big step forward in drawing wide attention to this matter. This is a young man's question, and if others speak out straight like Mr. Carney, something will have to move, and move quickly.

Yours, etc.,
E. KILBURN SCOTT.

ELECTRIC SHIP PROPULSION PATENTS.

At the Patent Office Court, Mr. W. P. Durtnall, consulting engineer, and the British Thomson-Houston Company, Ltd., brought a case before the Comptroller-General. The point in dispute was whether the Patent Specification No. 19,872, of 1909, did not, without mentioning the fact, include matter which was included in Mr. Durtnall's patent for the system of electrical ship propulsion No. 17,248, of 1905, in which a polyphase alternating-current generator, having a fixed or stationary armature, and a revolving field-magnet, was proposed, driven by a high-speed prime-mover, such as a steam turbine, supplying an induction motor, having more poles in than the generator, in order to form a speed reduction electrical gear. In connection with this system, Mr. Durtnall at the time stated in his specification that great efficiency in steam consumption for ship propulsion could be effected if propellers could be run at slow revolutions as compared with the said prime-mover speed. The Thomson-Houston application showed and described such a system, with the addition that when the vessel was at top speed the exhaust from the high-speed turbine driving the generator was taken to a further exhaust turbine coupled direct to the propeller shaft, as well as the slow-speed induction motor. But for the lower speeds it was proposed to allow the high-speed turbine generator to drive the propeller shaft by reason of the induction motor, means being made that the number of poles in the motor could be increased by means of change of stator connections. The Comptroller-General, after hearing the evidence, stated that he would give the matter his consideration and announce his decision in due course.

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Electrical Progress at Home & Abroad.

Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Hopes are being entertained in this area that the disastrous lock-out of boilermakers will speedily be settled. A working agreement has been reached between the masters and the men's representatives, and the matter is now to be the subject of ballot on the part of the men themselves. It will be remembered that the last ballot resulted in the rejection by the men of the terms arranged by their representatives, but there is reason to believe that this time the men will be favourable to resuming work. It is to be hoped that the last Edinburgh conference will be satisfactory, as there is no doubt that an immense amount of work has left this district owing to the lock-out. As against the cheering prospect of a speedy termination of hostilities, Tyneside has had a set back in the loss of the giant Cunarder which, it was confidently expected locally, would be ordered from Messrs. Swan Hunter and Wigham Richardson, Ltd. As a matter of fact, the order has gone to Glasgow, and a good lift-up to local engineering, including the electric branch, has passed us. Optimists are trying to find solace in the fact that in the past the Cunard Company has generally built its boats in pairs, and are hoping that in the near future there will be a sister ship on order, to be built on the Tyne. It is to be feared, however, that the wish is father to the thought. In the meantime, it is interesting to know that more trouble is brewing on the North Eastern Railway. The Union members on that organisation are girding their loins for a strike against non-union labour. As I understand that there are about 54,000 employés on that railway, of which only 9,000 are trades union members, it seems to me that if these figures are correct it will not be a difficult matter for the management to maintain passenger and goods traffic in efficient working order.

Electricity in Salt Works.

Some very interesting work which has recently been done by the Cleveland and Durham Electric Power Company, Ltd., although not on the banks of the Tyne, deserves mention, inasmuch as this company is included in the group of power-in-bulk supply undertakings operating in this area. In the existing sub-station of the Haverton Hill Wells belonging to the Salt Union, Ltd., the following plant will shortly be installed :—Three single-phase static air-cooled transformers of 20 kw. capacity with a ratio of 2,200 to 220 volts, manufactured by the British Thomson-Houston Company. One transformer panel of 2,750 volts of the pedestal type, also made by the British Thomson-Houston Company, will be erected on the high tension side, and fuses of Messrs. A. Reyrolle & Company, Ltd., will be erected on the low tension side, the total capacity of the sub-station being 50 kw. A 10 h.p. centrifugal reservoir pump motor of 1,140 r.p.m. at 440 volts of the slip-ring semi-enclosed type, controlled by an automatic liquid starter and two 15 h.p. well pump motors of 755 r.p.m. at 440 volts of the same type with star-delta starters are also installed. These motors were made by the British Westinghouse Company, Ltd., and the wiring was done by Messrs. Jarvis Bros., of Middlesbrough. The sub-station is supplied with current from the adjacent sub-station of Messrs. Bell at a pressure of 2,750 volts by an overhead pole line some 1,200 yards in length, the span between the poles being 60 yards. Swan-neck bracket guarding is fitted, and the whole installation is an example of good work applied to somewhat novel conditions.

Messrs. J. H. Holmes & Company.

My attention has been drawn to two excellent examples of electrical switchgears for mines which have been developed by Messrs. J. H. Holmes, of Newcastle. The first of these is a switch designed for starting up squirrel cage motors, which must, of course, be done in the stator circuit. The usual means is the use of auto-transformers, and on smaller sizes, when change-over switches from star to delta winding are employed it is sufficient to switch the motor directly on to the mains. The ordinary oil-immersed or overload-tripped switches do not offer adequate protection to the motor while running, as the heavy currents at the time of starting are many times the value of the normal running current. To meet this, the switch mentioned is fitted with an arrangement reducing the ampere turns on the tripping coils at start, reducing their sensibility. On closing the switch the armature of a no-voltage relay is closed on the face of an electro-magnet energised across two phases of the supply, so that the switch falls into place when a potential is applied and trips out on a failure of supply. The reduction of sensibility above mentioned prevents the switch from tripping on any current than that of practically a short circuit during the starting period, and a time limit adjustment restores the switch to ordinary overload conditions after a predetermined time has passed.

A Safe Mine Fuse.

The other appliance is a mine fuse which can be described as safe. As fuse boxes must be opened to replace a blown wire it is easily seen that they will blow again during replacement if the line fault has not been cleared, during the time that the box is open to the air. In a gassy mine this might mean a disastrous explosion. In Messrs. Holmes arrangement, however, the lid of the fuse-box is interlocked with the switch so that it is impossible to close the switch when the lid of the box is open, or to open the lid of the fuse when the switch is on. This is effected by placing the switch and fuse in the same case, the handle of the switch being interlocked with the fuse compartment. Both switches and fuses are immersed in oil, and to provide further means of safety the boxes are provided with wide metal-to-metal flanges, so that should there be sufficient power behind the fault to lift the oil in blowing the fuse and thus to cause an explosion inside the box, the flame would be extinguished before its emission to the surrounding atmosphere.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The large extension of the Birmingham Municipal Technical School, which has been approved by the City Council, and which will be carried out as soon as the land which has been purchased for the purpose can be taken over from the present lessees, is awaited with some impatience by certain departments of the school. This is particularly the case with the Metallurgical Department, in which for some years past a gradually increasing amount of work has been done with the electric furnace. The switchboard is arranged for 600 amperes, but owing to the difficulty of obtaining the current experiments and demonstrations are carried out with a comparatively small furnace, using not more than 350 amperes. The current for the whole of the school is supplied chiefly from the power-house upon the premises, though of late years there has been a small additional supply taken from the Corporation mains.

Gas-Engine Driving and Steadiness.

The power-house installation dates from the erection of the school, some 16 years ago. There are three Parker dynamos, each of 110 volts, 860 r.p.m., 350 amps. The driving is by three Tangye gas engines, each of 73 brake horse-power, all three running in parallel. Cotton Gandy

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belts are now used, and with these an exceedingly steady drive is obtained. When leather belts were in use, a great deal of trouble was experienced with slipping, causing sparking at the brushes, and from breaking, and the consequent injury to the dynamos. Under present conditions, however, a perfectly steady light, steadier, it is claimed, even than from the public supply, so that enquirers are often sent to the school to be convinced that a perfectly steady light can be obtained by gas-engine driving. There is a booster giving a supply from the Corporation main of 150 to 200 amps., so that, allowing for overload on the dynamos, the total available supply is about 1,400 amps.

Insufficiency of Power Supply.

From this the whole of the building has to be lighted, including several large shops and lecture-rooms lighted by arc lamps on the inverted reflector principle. In addition, there is a motor of 7 h.p. to be driven in the fitting and turning shop, with a number of smaller motors in other departments, so that it is not often that even the present small demand of the Metallurgical Department can be fully met. It is not only the smallness of the supply that hampers this department, but also its intermittent character. It is very much desired to have an electric furnace in which the full supply of 600 amps. could be utilised, but with present resources this would be possible very rarely indeed, if at all. Anything in the way of research work is at present practically impossible, since there is no certainty that sufficient current can be obtained at the requisite moment, and without continuity there is little research that can be done satisfactorily. All the departments concerned in such matters confidently anticipate that when the extension of the building takes place the electrical resources will be greatly amplified. But this is not expected to happen for about 18 months, and the metallurgical side would no doubt be glad if the Committee could see its way to some temporary augmentation of the present supply, especially in view of the growing appreciation in the district of the importance to its industries of scientific training and research.

Growth of the Electro-plate Trade.

Progress continues to be made in the acceptance of electricity from the public main as a motive power in the leading Birmingham industries. In the jewellery trade practically all the power required is, or soon will be, obtained in this way. In the heavier industries the department is able to report a number of enquiries, some of which have resulted in good orders for high tension supplies. The growth of the electro-plating trade in Birmingham is likely to prove profitable to the public supply. Of late years, Birmingham has become more and more a formidable rival to Sheffield in this industry, and it is estimated that there are now about 10 electro-plating firms in Birmingham to one in Sheffield, whilst the number in Birmingham, as compared with 10 or 15 years ago, has multiplied a hundredfold. Some of the firms engaged in this business take the Corporation supply and transform it for plating purposes, while a greater number are customers for power in the ordinary sense.

The Electric Club.

Most gratifying reports were presented at the annual meeting of the Birmingham and District Electric Club, held at the Colonnade Hotel on Saturday evening last. The treasurer had a balance in hand of between six and seven pounds, and the membership showed a very considerable increase. Mr. F. W. Foster, A.M.I.E.E., of Siemens Brothers' Birmingham office, was unanimously elected President for the ensuing year, and Messrs. T. H. Hunter, of the British Thomson-Houston Company, and Joseph Hill, of the Reliance Works, Vice-Presidents; whilst the Honorary Treasurer (Mr. E. A. Morgan) and the Honorary Secretary (Mr. W. G. L. Riddle) were unanimously re-elected, and Mr. Norman Deykin was appointed Assistant Honorary Secretary. There were several changes made in the Committee, which was constituted as follows: Messrs. Norman Deykin, G. T. Wood, W. H. Varnon, A. E. Cunningworth, H. Roberts, A. Adams and W. H. Whitehouse. It was decided to make the club dinner an annual affair, and the date of the next was provisionally fixed for the second Saturday in February. A similar decision was come to with regard to the ladies' evening, and the next will probably be arranged for March.

Trade with the East.

Most manufacturers of electrical machinery and requisites in the Midlands continue to be fully employed, and in some cases a good deal of overtime is being worked. These, as well as consulting engineers and others who act as buying experts, report a rapidly increasing trade from this district with the Far East, and especially with China. In fact, if the export of electrical material to China should continue to progress at the present rate of increase, the Chinese lantern, at least its historic method of illumination, should soon be a thing of the past. Both in the seaports and in the inland towns there are growing demands for electricity, not only for lighting but also for power, and supply companies are being formed for a great many inland districts, while in some cases the local authorities are taking the matter up. The Treaty Ports are the scene of a great deal of electrical development in various forms. Shanghai, for instance, has more than doubled its supply during the last twelve months. British manufacturers, judging by local experience, must be doing very well out of this awakening of China to electrical possibilities. Orders are continually coming in for cables, lamps, fans, and fittings and accessories. One Midland firm alone sent out last week 50 miles of cable, and every week two or three large consignments of electrical material go out from this district to the Far East.

LANCASHIRE.

("Electrical Engineer" Correspondent.)

MANCHESTER.

Trade continues to boom here. The condition of the cotton industry is better than it has been for over a year, and already this improvement has made itself felt in every other branch of Lancashire trade. There is, of course, still room for further improvement, but electrical firms can be getting themselves ready for orders from this district. The coming year, granted fair conditions such as now promise, should see a good number of conversions in the driving of cotton and other textile factories.

Exhaust Steam.

It is interesting to note that last Saturday, at a meeting of the Lancashire Section of the British Association of Textile Workers, a paper was read by Mr. C. S. Richards on exhaust steam as a source of power. Mr. Richards dealt upon the economic advantages of the exhaust steam turbine for using waste steam, and impressed upon his audience the fact that this benefit could only be obtained by the aid of the electric drive, replacing or supplementing the existing mechanical drives. When it is realised more widely among mill-owners that by the addition of exhaust turbines, about double the power can be attained from the same amount of coal as at present is being used for their reciprocating engines, there will be a run on the electrical manufacturers, and quite time too. Unfortunately it is not possible so far, without scrapping the old sets, to secure the advantages of a combined reciprocating engine and low pressure turbine, unless work is provided which calls for the utilisation of about double the amount of power hitherto required. A method, however, perhaps almost efficient, suggests itself. This is the alteration of the existing cylinders, so that one half of the engine might work as before on the high pressure steam, while in the other half (converted especially for the purpose) the resulting spent and ordinarily wasted steam could be expanded down to give up a good proportion of its energy. The only difficulty is the friction in the low pressure cylinders; if this can be overcome then there would be every chance of this method coming into use. It would not necessitate the immediate adoption of the electric drive, but it would mean that with the same existing engines, the same power would be obtained with a greatly reduced coal bill, and the fact that such improvements could be made would shake the confidence of the old-fashioned mill-owners in the efficiency of their present

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engines, and make them more ready to believe what the central station man tells them on the subject of electric driving. Mr. James Airey, the consulting marine engineer, of West Hartlepool, who has made a special study during the last 25 or 30 years of piston rings and rods, has recently perfected a perfectly steam-tight and yet practically frictionless piston and piston valve packing ring, which he claims renders it possible to use specially designed reciprocating engines having large low pressure cylinders only, instead of low pressure turbines to use the exhaust steam from ordinary reciprocating sets. This invention seems distinctly applicable in the conversion of old mill engines on the plan I have suggested above.

The I.E.E. Local Students.

The kindness of the ELECTRICAL ENGINEER in sending advance copies of Mr. H. L. Carney's paper on the Electrical Industry, to every student in the section, some days before the meeting, was greatly appreciated, and has increased the demand for some scheme of printing all the papers, at least in abstract, before they are read. The effect would be greatly increased interest, larger attendances and more valuable discussions. It is a growing question which the Council ought surely in justice to the rising generation of electrical engineers, to seriously deal with at once. The speech of Mr. A. Bruce Anderson was a splendid and lucid explanation of the means and methods of financing industrial concerns in general and electrical engineering works in particular; and although, no doubt, many students are not quite so certain that his plea for Protection was not founded on a fallacy, there was not a single student who did not leave the meeting with very much clearer notions of the high financial side of the business than before he came. This is the sort of knowledge which students want, but seldom have the opportunity of getting, except by experience.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

Electric light and power are likely to be brought increasingly into use in connection with the equipment of motor driven cruisers and yachts. On the "Ketch," for instance, a Clyde yacht of 111 tons, built in 1906 by Fyfe, of Fairlie, for Mr. Kenneth Clark, the well-known Clyde yachtsman, a small dynamo is being fitted in the machinery room, driven by one of the main engines through a Hans Renold silent chain. A clutch will be so arranged that when electric power is not required, the chain and dynamo can be put out of gear and full power given to the engine for propelling purposes. The power generated by the dynamo will operate direct an electric windlass to be used for weighing anchor and hoisting the heavy sails. In the engine room there will also be a battery of accumulators capable of lighting the entire yacht for several days at a stretch without recharging. Electric light will be fitted to the binnacle, there will be an electric siren for use when the vessel is under power, and electric radiators will be supplied to the principal apartments.

Glasgow Tramways.

Perhaps no better indication of reviving trade could be given than the increased amount of business done by the Glasgow Corporation tramways during the past six months as compared with the corresponding period of last year The 94½ miles of line in existence then are now increased to 97¾ miles, but what is more to the point is that the number of passengers carried since June is some 5,000,000 in excess of the number from June to December, 1909, and the receipts show a corresponding increase of £25,644.

Glasgow Local Section.

The monthly meeting of the Glasgow Local Section of the Institution of Electrical Engineers which was to have been held on the evening of Tuesday last, December 13, has been postponed owing to the sudden death of Mr. James R. Barr, Associate Member, who was to have read a paper entitled, "Some Considerations Relating to the Parallel Working of Alternators." The paper had been printed by the parent institution and circulated amongst the members, but naturally in the meantime no arrangement has been come to as to when it may be read and discussed. Mr. Barr was on the staff of the Heriot Watt College, Edinburgh.

New Music Halls.

Glasgow is to have another three new music halls, all of which will bring grist to the Corporation mill, or, rather, mains, and wiring work for local contractors. One of these halls is already almost finished and the men are at present being kept on it night and day with a view to opening on the 19th inst.

It is situated in Waterloo-street, on the site of the old Waterloo Rooms, is designed after the Moorish style—being, in fact, a copy, as its name indicates, of the Alhambra of Seville—and it has seating accommodation for some 1,250 persons. The Corporation Electricity Department have carried in their supply at two points, so that there will be two sources of supply always available. The wiring installation, which has been carried out by Messrs. Johnston, Park & Company, consists of 5 arcs equivalent to 10 amps., stage arcs taking a total of 25 amps., 2,000 Tantalum lamps equal to 359 amps., and a biograph taking 17 amps.

Other two large music halls are also to be erected at an early date, one in Bridgeton, to be called the Olympia, and the Savoy at the corner of Hope-street and Renfrew-street, to be called the Savoy. The latter will have seating accommodation for 2,000 people.

Improved Trade.

With the Boilermakers' lock-out settled and the Parliamentary election past, it is to be hoped that business will now be allowed to settle down to the steady development which is long overdue. As stated in these columns a week or two ago there is a large amount of electrical work waiting to be done in the shipyards if the other work was forward, and the placing of an order for a new Cunarder with Messrs. John Brown & Company, of Clydebank, should also help to keep local houses on the *qui vive*. It is good news to learn that the North British Locomotive Company are to start all their various works on a night shift after New Year.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Orders have been issued that the short circuit brake on the German State railways and the Prusso Hessian street trams is only to be used on occasions of great urgency, as its sharp and powerful action is very injurious to the motors and toothed gearing. The switch by which it is applied is to be kept sealed up, but in such a way that should an emergency occur there is a minimum of delay in applying the brake. This new rule is somewhat surprising as the brake has proved most valuable on street tramways.

Gas and Water Power and Earth Currents.

A Berlin engineer proposes, in order to protect gas and water pipes from subterranean currents to earth electrodes near the pipe. The positive poles are connected with a source of low voltage current, the negatives with the pipe. If escaped current is about, say from an electric tramway, it is kept in the pipe so that the electrodes alone suffer. They are usually cast-iron rods or pipes. The voltage required is from 2 to 10, according to the situation of the pipe and the conducting power of the soil. The cost is very small.

Picture Telegraphing.

An important step has been attained in picture telegraphing. According to the latest method the expensive selenium cell is not wanted. The new method depends on the action of an electro-magnet on the cathode rays.

Wireless to German Colonies.

At the commencement of the new year Germany will have a fairly complete system of telegraphy between herself and her colonies. An installation has been built which will enable communication to be made with German East

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Africa. As noted recently in these columns a very successful service of communication exists between Germany and German West Africa. An installation is to be erected in German Oceania so that East Africa, West Africa and the German Islands in the Pacific will form the base of a vast triangle with invisible sides, having Prussia at its apex. The whole present and future cost of installation comes to about 10 million marks, the cost of a very small warship.

Trouble in High Tension Currents.

Aviators are beginning to complain that cross-country wires carrying currents of extremely high voltage are a source of great danger to aeroplanes. The French aviators agree with their German confreres in this. They agree with the suggestion that the masts should be painted a brilliant red so that they can be seen from a good distance. The demand seems perfectly justified for overhead wires must always be a source of danger to anybody approaching them whether in a dirigible, plane, or otherwise, and especially to repairers. The extra cost of putting the wires in insulating pipes underground will have to be met before long. It would be wise to commence now, even for purely financial reasons.

Diamond Making in the Singing Arc.

Professor Rosa calls attention to the enormous development of heat in the singing arc. He used a small fireclay crucible as an electric furnace in which he placed two vertical electrodes of sugar carbon, giving 0·33% of ash. He covered the lower pole to a depth of three millimetres with the same carbon in fine powder. When a singing arc had been acting between the poles for some hours they were covered by a graphitic crust. When the singing arc was accompanied by a rapid succession of powerful sparks, tiny crystals of great hardness, and having a s.g. of 3·2 were obtained. These are probably diamonds, but they may not have been obtained in sufficient number to allow of any certainty that they are not carborundum. Professor Rosa regards their formation as a proof, in either case, that the singing is hotter than the ordinary arc.

Company Notices.

A new power station to supply Northern Pomerania is to be founded at Belgard by a company having a capital of 3,852,500 marks, divided into 7,705 shares of 500 marks each, and called the Oberlandzentrale Belgard Aktien-Gesellschaft.

The Reiniger, Gebhert & Schall, A. G. Berlin-Erlangen is paying 12% on its capital of 2 million marks, for 1909–10, the same as for the year before, although the net profits fell off by 9,628 marks.

The Amperwerke Elektrizitats A.G. of Munich, at the recent general meeting approved the proposed dividend of 4½%, and approved the increase of the capital from 3 to 4 million marks, in order to buy up the Elektrizitatswerk Osten, also of Munich. The retiring directors were re-elected, and MM. von Landmann & Pilz were added to the board.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The Electric Vehicle discussion which has been in progress in your columns has been followed with keen interest here, where expert opinion does not hesitate to declare that the traditional conservatism of the Old Country is stifling the development of a most important and profitable industry. Electrical engineers on this side claim absolutely to have solved the problem of self-contained electric transport, and are astonished that English manufacturers, with two or three exceptions, should still maintain such an attitude of scepticism. They point out that the matter is very largely in the hands of central station managers, and that if they would combine to give the electric vehicle (both for pleasure and for commercial purposes) a fair opportunity, and be content to make a loss at the outset in order to set the industry fairly on its feet, they would be doing a splendid service to the cause of electrical progress. Apart from the question of the private electric automobile, there is an immense field for development in connection with the storage-battery tramcar. Such cars are now in regular operation in this city and have proved an undoubted commercial success. The experimental stage is over, and though it was carried out under tests which are never likely to arise in actual practice, it came through them with absolute success. The small car already described in these Notes (the Edison-Beach car) has been followed by a double-truck car with which successful experimental runs have already been made, while further demonstrations under severe tests are now in progress. This car is a little over 40 ft. long and 7½ ft. wide, and has seats for 40 passengers. Equipped with 190 Edison cells of the A-8 type, it weighs 29,000 lb. fully loaded, or 725 lb. per seated passenger. It can attain a maximum speed of 35 m.p.h., and its average power consumption is 650 watts per car mile, acceleration on the level being 1 m.p.h. per second. The load is mainly carried on the driving wheels, which are of 30 in. diameter on a base of 4 ft. 10 in., and are driven by an 85-volt 30-ampere General Electric motor while the motor speed at the operating potential of 100 volts is 850 r.p.m. The car will, of course, carry a good many more passengers than the number for which there is seating accommodation, and for the extra load the "straphanging" straps are replaced by eight steel-tube vertical stanchions running from floor to roof and two longitudinal stanchions running along the length of each side of the car at a convenient height. These also act as supports for the body and roof of the car. Each of the two trucks has two 30-inch driving wheels, and the underframe is of one-piece steel, the whole scheme of construction being successfully designed to reduce friction and vibration to a minimum.

A Point for Tramway Managers.

This new 40-foot single-decked car opens up an unlimited field for tramway corporations. It has been proved that it can be operated at a less cost for power per car-mile than any car operated either on the trolley system or the conduit system, and the whole cost of the upkeep of both these systems is thereby eliminated. There is no wastage of energy, no conduit-cleaning staff to pay, no cable and standard renewals, no inspection staff to provide for, and no danger from falling wires, and no risk of stoppage through snow or wet or short-circuiting, or any other cause. Each car has all its powers self-contained, and will run for 12 hours without re-charging, though in practice it is not desirable to run for more than half-a-day on a single charge. It looks like the dawn of the Golden Age for tramway managers, but all these statements are hard solid facts which any tramway manager not too hidebound to refuse to be convinced can come here and have demonstrated to him beyond the shadow of a doubt. Moreover, there is nothing complicated, bulky or unsightly about these cars. Except for the improvement in the truck construction which, as already indicated, is extremely novel and ingenious, the cars look exactly like any other single-deck cars. The storage batteries are tucked away under the seats out of sight and occupy no space that could otherwise be occupied (except perhaps by the boot-heels of the passengers), and there is no smell, no risks from high-voltage or any other source of danger whatsoever.

An Electric Vehicle City.

In connection with this discussion, your readers are likely to be interested in a notable development of the social side of the electric vehicle question. Illinois has a centre which may fairly be called an electric vehicle city. This is Rockford, which with a population, all told, of 45,000, has a total of nearly 200 electric automobiles exclusively for pleasure service. The local central station charges its private consumers threepence per kilowatt-hour, measured from a separate meter, as compared with 6¾d. per kilowatt-hour for lighting, and the central station's average income from each car is five shillings per week. The city has 10 public garages at convenient points which purchase energy from the central station at 2d. per kilowatt-hour. Rockford, of course, is "very small potatoes" compared with cities such, for instance, as Chicago, but the progress made is a very interesting illustration of the developments going on in this particular matter. In Toledo, there is one garage alone which is capable of giving accommodation to 175

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electric vehicles, of which there are upwards of 500 in use in the city. In this particular garage the charging equipment consists of five General Electric mercury vapour rectifier outfits, and energy is received at 110, 220 and 440 volts, 60 cycles and 30 cars can be charged simultaneously. Each car, it is found, requires on an average 107 ampere-hours per day, which, with an average battery pressure of 75 volts, represents about 240 kw. hours per car per month. As to the commercial side of the question, the commercial electric vehicle contest in New York last month may be referred to. For this event there were 40 entries, among them being a General Electric delivery van built nine years ago, and another only 18 months younger, each of which accomplished 30 miles a day during the contest. Seventeen electric vans built by the General Vehicle Company were also entered, and the New York Edison Company entered five—a 1,000 lb. lamp wagon, a 2,000 lb. repair wagon, a two-ton freight collecting and delivery wagon, a 3½-ton pole-hoisting truck, and a 5-ton cable-winch truck. The Edison Electric Illuminating Company, of Brooklyn, entered a similar 5-ton cable truck. The United Electric Light & Power Company entered a 2,000-lb. repair wagon and a 3½-ton cable truck. There were also entered by the owners a 2,000-lb. bread wagon, a 3½-ton milk truck, two beer trucks and one package-delivery wagon. The manufacturer of the above trucks, the General Vehicle Company, entered a 3,000-lb. furniture wagon which easily covered the required 65 miles on one charge, and a 1,000-lb. vehicle which carried its full load for 65 miles, and after the finish of the run officially made a total of 87·6 miles without exhaustion, thereby showing that the modern electric vehicle can readily cover all the mileage that is needed in a working day. Among the trucks entered by owners were one 1,500-lb. Chicago vehicle, two 1,000-lb. Lansden wagons and one 3,000-lb. Commercial. Among the manufacturers' cars were a 1,000-lb. Lansden wagon in the transfer class and a 1,500-lb. Lansden in the distributing class. Among the manufacturers' cars the winner in the transfer class was a 1,000-lb. General Vehicle at a cost of 2·53 cents per ton-mile, and the winner in the distributing class was a 1,500-lb. Lansden at a cost of 1·06 cents per ton-mile. Among the owners' cars the winners were as follows: A 1,000-lb. General Vehicle, cost 1·08; a 2,000-lb. General Vehicle, cost 0·84; a 3,000-lb. Commercial, cost 0·48; and a General Vehicle, cost 0·40, the costs being in cents per ton-mile for the electricity consumed, with energy at 4 cents per kilowatt-hour. It is noteworthy that the cost of fuel and engine oil for the competing gasoline cars averaged 46% higher than the energy for the electric cars. The maximum variation in cost per ton-mile in any one class for the electric vehicles was only 4·6%, while the gasoline cars in a class varied in cost as much as 214%.

New Electric Locomotives.

Some important new features are embraced in two electric locomotives which have just been built for the Baltimore and Ohio Railway by the General Electric Company in conjunction with the American Locomotive Company. The general appearance of the engines corresponds, roughly, with the usual double wedge-ended type, but with platform and rail surrounding each end for inspection purposes and coupling, etc. The cab platform is thus 38½ ft. over all. The running gear is articulated, and consists of two four-wheeled trucks connected through a massive hinge which allows the two trucks to support and guide one another without interfering with the lateral flexibility in curving with a long wheel base. The framing is massive, and the sections are heavier than actually required for mechanical strength on account of the necessity of obtaining ample weight for tractive effort. The side frames are steel castings 5 in. thick, bolted together through steel end frames and bolster castings of a box girder pattern. Draft gear and buffers are carried on the outer end frames. The wheels are steel tyred, 50 in. in diameter, with the motor gears mounted directly on extensions of the wheel hubs. The journal boxes are of cast steel, and are carried in pedestal jaws between shoes 9 in. wide, and have journal bearings 7½ in. by 14 in. The weight of the locomotive is carried on the boxes through semi-elliptic journal box springs equalized together to obtain the most uniform possible distribution of weight over groups of springs. This construction concentrates the principal hauling and buffing strains in the trucks themselves and relieves the platform and cab of all stresses except those due to its own weight and that of the control and operating apparatus mounted on it. The motor equipment consists of four 600-volt commutating type (General Electric 209), which exert a combined tractive effort of 46,000 lb. at 14 m.p.h., with 25% co-efficient, corresponding to a steam locomotive output of 1,700 h.p. But in practice the electric locomotive exerts a much greater power. By means of the multiple unit control, which is a feature of these locomotives, two of these 90-ton units can be coupled together and operated by one engineer in the forward cab. All the motors are controlled simultaneously by one operating handle, and one engineer thus has under his control a maximum capacity of 3,400 h.p., or a maximum tractive effort of 90,000 lb. developed from one 180-ton locomotive. But it is to be noted that 180 tons represent approximately the weight of a single large steam locomotive and its tender, and that in the steam locomotive only half this weight is on drivers, while in the electric type the whole 180 tons is on drivers and is capable of being applied for developing tractive effort. With a light passenger train, a single 90-ton electric locomotive will develop speeds of 25 m.p.h. to 35 m.p.h. on the level. The new locomotive is therefore an engine capable of handling the heaviest freight trains over the tunnel grades or the highest speed passenger trains at the greatest speed consistent with its tunnel service.

Electric Cooking on Warships.

The navy department recently installed electric range and electric bakers on the battleship "Dixie," and is considering electric cooking on practically all the Navy's ships. This is the outcome of the report made by a board of United States Navy officers who recently conducted a series of comparative tests of electric ranges and coal ranges. Meats and vegetables for from 100 to 150 men were better cooked in almost half the time by electricity, no matter whether fried, boiled, broiled or baked. Ten pounds of meat were roasted in one hour and forty minutes by 7 kw. hours, whereas it required two hours and twenty minutes for 41 lb. of coal to accomplish the same result. The final conclusion of the report was that the electric range should supersede the coal range on board ship because of its cleanliness, economy of time, space, and operating, and elimination of coal boxes, draft troubles, soot accumulation and excessive heat in the galley.

Current Items.

The Westinghouse Electric and Manufacturing Company have been awarded a contract involving more than $1,000,000 for the apparatus to be used by the New York, New Haven and Hartford Railroad, which will electrify the Hoosac Tunnel under the Hoosac Mountain in Massachusetts. This tunnel was completed in 1874 after years of work. It is 4¾ miles long. The electrification work is seven miles, and it will abolish for good the long-standing trouble of smoke and foul gases while trains are passing through.

The electric railways of this city carried during the current year 458,000,000 more passengers than they did 10 years ago. At that period the surface cars carried 360,000,000 and the electrified 174,000,000. The present figures are: surface cars 430,000,000, electrical 293,000,000, and subway cars 269,000,000.

ELECTRIFICATION OF GERMAN RAILWAYS.

A report is current in Berlin, says the "Standard" correspondent in that city, that Herr von Dernburg, the ex-Colonial Secretary, who has just returned from the Far East, has accepted, or is about to accept, a seat on the board of directors of the Allgemeine Electricitäts Gesellschaft, the largest electrical firm in the world, with a view to becoming its president, when the present occupant, Herr Emil Rathenau, who is over 70 years of age, retires. It is also stated that Herr von Dernburg's programme as controller of this gigantic concern would include the gradual substitution of electricity for steam as the motive power on all the German State railways. Herr von Dernburg himself and all other persons connected with the projected arrangement maintain a complete reserve, but the story is regarded as authentic in well-informed financial and industrial circles.

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ELECTRICALLY-DRIVEN AIR COMPRESSORS.*

By Chas. McCann.

In considering the different methods of driving compressors, the proposition at once resolves itself into the one question of cost of power delivered at the drill.

We will, for the purpose of this paper, assume that a new deep level mine, 4,000 ft. vertical depth, with an incline equivalent to a further 1,000 vertical feet depth, on which incline there are 10 levels, is to be equipped with a plant to run 100 working drills—10 to each level—each drill requiring on the surface 120 cubic ft. of free air compressed to 80 lbs. gauge pressure.

Experience having proved that two stage compressors, with pre-coolers and inter-coolers reducing the temperature of the air between stages to as near atmospheric temperature as possible, are the most economical, we will assume this class of machine. Objections have been raised to pre-cooling on account of delivering wet air in the mine, but I might point out that this is easily overcome by installing ordinary steam separators in suitable places.

We have available three alternative methods:

1. Large compressors direct coupled to steam engines.
2. Large compressors belt-driven by motors on the surface.
3. Small compressors belt or gear-driven by motors in mine.

Assume that in cases 1 and 2 there are installed 30 drill compressors, then the only difference in running expenses will be in the cost of power and capital charges, the air-power transmission efficiency remaining the same in both instances.

I think that in view of the present electrification schemes, it will hardly be necessary to enlarge upon the point that the power produced by the electric motor supplied with current from a central station, is cheaper than power produced by a comparatively small local boiler and engine plant. Exhaustive investigations show an average difference in favour of the motor of 0·3d. per h.p. hour, which, on our 100 drill plant would mean 1,500 h.p. × 0·3 × 24 = £45 saved per 24-hour day, but as the compressors run almost on no load for several hours, we may assume about £23 10s. saved per day, or, per working year of 310 days, a total saving of £7,285 for power charges only.

Capital expenditure would be as follows:—

Three 30-drill compressors with engines, boilers, etc.	£30,000
Three 30-drill compressors with motors, etc. ..	£15,000
Difference in favour of motors	£15,000

and £15,000 at 12% = £1,800 per annum, saved in capital charges which, added to the above mentioned saving of £7,285, amounts to £9,085, saved by installing motor-driven compressors instead of steam-driven compressors.

In the case of older mines, already equipped with steam-driven compressors, the annual saving on the same power basis would not be quite so high, as the money has been spent on the steam plant, and the capital charges would still have to go on until its cost has been written off, despite the fact that it is of no further use. Then we find—

Saving in power costs		£7,285	0 0
Less capital charges on old plant, 12% on £5,200	£624 0 0		
Less capital charges on motors, etc., 12% on £3,000 ..	360 0 0		
		984	0 0
Total annual saving ..		£6,301	0 0

obtained by scrapping the boilers and engines and substituting motors. (The above figures assume that about half the cost of the steam plant has already been written off).

A prominent local engineer stated recently that electrically-driven compressors are 25 to 50% less economical than steam-driven. This remarkable statement has been passed by the engineering community without comment. I think the above figures prove it to be absurd, but, as even absurd statements of this nature are frequently quoted by persons who cannot or will not think for themselves, I have endeavoured to prove that this gentleman was wrong and that the diametrically opposite is the truth.

We hear a lot about the great advantages of the straight line motion in the steam-driven compressor, but I confess I fail to see them, because when the steam cylinder is delivering maximum power, the air cylinder is requiring minimum power and *vice versa*; it therefore follows that although there *is* a straight line motion between the air and steam cylinders, some of the power used is transmitted to and fro through the crankshaft.

I have noted this point because it is quoted as one of the strongest points which the opponents of the electric motor drive bring forward in favour of the steam drive.

Taking now alternative 3, *i.e.*, small motor-driven underground compressors, we have several factors to consider, in order to obtain capital and power charges. We will take first the transmission of energy from the surface to a mean distribution point, 4,500 ft. below the surface, the surface being 5,500 ft. above sea level, and the average barometer pressure on the surface 12·2 lb. per sq. in. The air pipe friction, minus the increased pressure due to static head, and the loss in the electric cable may be taken as equal, and therefore left out of further consideration. The temperature of the air leaving the compressors in any case will be about 240° F., but in the case of the compressor on the surface, before the air has got very far down the shaft, it will have fallen to about 80° F. This means a loss of about 23½%, due to the decrease in volume.

The next point to consider is the relative volumetric efficiency of the air compressors at these levels. If we assume the volumetric efficiency of a compressor at sea level to be 97%, then owing to the reduction in the density of the air, the volumetric efficiency at 1,000 ft. altitude (*i.e.*, 4,500 ft. down our mine) will have fallen to 94%. The loss of capacity is 3%, but the decrease of power required is only 1·8%. At 5,500 ft. altitude the volumetric efficiency drops to 79½%, the loss of capacity is 17½%, but the decrease of power required is only 9·3%; therefore the power required by the compressor down the mine will be 8% less than that required by the compressor on the surface, temperature and pressure being constant; but, as we have seen above, 23½% of the work done by the compressor on the surface has been lost in the transmission pipe in the shaft, so that to deliver the same power at the distribution points, the underground compressors can be 17½% smaller, and the horse-power of the motor 31½% less, but unless we insulate the air pipes from the distribution points to as close to the drills as possible, the most of the 23½% saving will have been lost, and as insulation would cost but a small fraction of the value of the power saved by it, it should be put on on all the air mains.

We will therefore assume that these pipes have been insulated, and that the loss between the compressor and the drill is 5% instead of 23½%. Our motors for a 10-drill compressor would then be, say, 25% smaller than on the surface, *i.e.*, 112½ h.p. each. This would also allow for the losses due to using smaller units.

The cost of this insulation then becomes—

Cables and connections	£2,500
Chambers cut in rock	2,000
Ten 10-drill compressors and motors, complete ..	12,000
Making a total of	£16,500

Tabulating the different results we get—

SCHEME 1.

Capital charges at 12% on £30,000	£3,600
Working costs 0·73d. per h.p. hour, 4,500 hours × 1,500 h.p.	20,520
Total compressor charges at distribution point per 100 drills	£24,120

SCHEME 2.

Capital charges at 12% on £15,000	£1,800
Working costs 0·5d. per h.p. hour, 4,500 hours × 1,500 h.p.	14,063
Total compressor charges at distribution point per 100 drills	£15,863

SCHEME 3.

Capital charges at 12% on £16,500	£1,980
Working costs 0·5d. per h.p. hour, 4,500 hours × 1,125 h.p.	10,547
Total compressor charges at distribution point per 100 drills	£12,527

* Paper read before the South African Institute of Electrical Engineers.

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The above comparison speaks for itself, and, I think, is a fair one, and shows the great saving which may be obtained by using up-to-date methods. As will be seen, the capital charges make but a small difference in the annual account. It is therefore obvious that any money spent in improving efficiency will be money well spent.

There will be, as of course you all know, yet another alternative: that is, the purchase of compressed air in bulk, but as I have no particulars, such as price, temperature and pressure of supply, etc., I have not included it in these remarks.

There are two other details, however, which might well be included in this paper, and they are the ventilation of the mine workings and the re-heating of air. With regard to the ventilation, I consider that a combined ventilation and air-power scheme is a happy solution of the underground ventilation question. Turbo-compressors are to be used in connection with the V. F. & T. Power Company's supply scheme, proving that these machines, at any rate in the larger sizes, are economical, and I fail to see why they should not be so in the smaller sizes. A multi-stage turbo-compressor, with inter-coolers between stages, a pre-cooler and an after-cooler with a steam trap to collect excess moisture in the air, and a re-heater near the drills would, in my opinion, make an ideal plant (as far as air plants can be ideal). Compression would, in a six or eight stage compressor, follow closely the ideal isothermal curve, the air being drawn from the surface through a pipe (in the event of the air in the shaft not being pure) would be delivered cool and pure for ventilating purposes, and for power purposes, hot and pure. During the interval between blasting and the men returning to work, which could be reduced to a few minutes, the compressor would be delivering its full capacity in cool dry air at the very point where such air is wanted, and at a cost of practically nothing, as the only power required would be that used to overcome friction and motor losses, the several compression stages being put in parallel for this period.

With regard to re-heating, there have been several papers and discussions in various technical societies on this subject, but, while the speakers have agreed that great increase in efficiency is obtained by re-heating, they have one and all, as far as I can discover, been compelled to admit that re-heating by means of fires underground is impractical on account of the danger caused by the products of combustion, and those who mention electricity at all, dismiss it with a few words. I, therefore, wish to point out that it is the only practical way to re-heat underground, and will be found highly efficient.

An air-rock drill requires pressure and volume, and with a constant pressure the volume increases in direct proportion to the absolute temperature, so that if we wish to increase the amount of work available by 50%, we can do so by increasing the absolute temperature 50%. With the best obtainable present-day mining conditions, we have a pressure of 75 lb. gauge and a temperature of 80° F. = 541 abs, adding 50% = 811 abs = 350° F., or an increase of 350° − 80° = 270°. As the specific heat of air is 0·237, and the weight of one cubic foot of air at 75 lb. g.p. is 0·456 lb., the heat required to increase the volume 50% = 270 × 0·237 × 0·456 = 29·2 B.T.U. (about). As the heat required originally to produce this cubic foot was about 480 B.T.U., we see that, theoretically, to increase the volume 50% only requires about six% of the original energy; or, looked at in another way, 1 h.p. hour = 2,545 B.T.U., costing 0·5d., and with an efficiency of 80% will expand 530 cubic ft. of air to nearly 800 cubic ft. Now each drill takes 120 cubic ft. of free air per minute, this compressed to 75 lb. g.p. at constant temperature = 16·6 cubic ft., say, 1,000 cubic ft. per hour. It will, therefore, take less than 4 h.p. to run an extra drill as against 15 h.p. in the compressor; or, in other words, our 100-drill compressor plant, taking 1,500 h.p. on surface, can be converted into a 150-drill plant by simply adding re-heaters, at an additional first cost of, say, £100 to £300, and an additional power consumption of 200 h.p.

These re-heaters would be quite simple, and should have an efficiency of well over the above noted 80%. Working at a low voltage, there would be no danger to life, and automatic control would be easily applied so as to maintain the amount of re-heating between the desired limits. The maintenance would cost practically nothing.

Although I think I have proved the efficiency of electrical re-heating, there is one objection which I consider fatal in connection with drill work, and that is, that although the air being expanded in the drill would be exhausted at a low temperature, the hose and the drill would be too hot to handle. I can imagine the remarks a miner would make if asked to use a drill at a temperature of 350° F., or even 200° F. There also would be lubricating troubles, the same objection being sustained would, of course, increase the size of our underground compressors in Scheme 3, as we could not take advantage of a temperature much above 150° F. These objections do not hold good in the case of winches, pumps, etc., driven by air motors, but if current is taken to these machines for re-heating, you might as well take a little more—do the *driving* with electric motors, and do away with the air altogether.

WIRELESS COMMUNICATION AS APPLIED TO RAILROAD LINES.*

By Lee de Forest.

A subject of this type must necessarily deal largely in futures, yet the demonstrated possibilities of the radio-telegraph and telephone and the strict requirements of the railway service are to-day so well known by the experts in each separate field, that, by conferring and co-operatively working together, it is reasonable to suppose something tangible, and of real value to both may rapidly result. The possibility of telegraphing wirelessly to moving trains over considerable distances by means of the old-fashioned spark telegraph was, I believe, first demonstrated in 1905 over the Chicago and Alton Railroad out of Chicago and St. Louis.

Thanks to the enlightened interest which the officials of that road took in my proposals, I was allowed the privilege of experimenting on the fast daylight express between St. Louis and Chicago. Two horizontal antenna wires were first run on insulators along the top of the train and connected to a receiving instrument installed in the parlour compartment of one coach. Earth connection was made to the trucks. The 15 kw. station at East St. Louis, about two miles from the trackside and the 10 kw. station at Chicago, a quarter-mile from the rails, were used as transmitters. No attempt was made at that time to transmit messages from the train. But, unfavourably situated, as both these stations were so far from the tracks, messages were clearly received on the flying train when 30 to 35 miles from these stations.

Subsequent experiments at New Haven, Conn., and Toronto, Canada, demonstrated the correctness of my view, that the track rail system, including the mass of telegraph or telephone wires along the right of way served not only as a conducting zone or wave chute along which the electric waves preferred to travel; but also acted as a net to catch waves coming transversely and obliquely towards the right of way, and then distributing in both directions along the track a surprisingly large amount of electric energy.

On account of this directive action of the telegraph wires, it is easy to pick up strong wireless telegraph signals by a wave detector connected to a short horizontal wire stretched parallel and near to the telegraph wires, and at a surprisingly large distance from the wireless transmitting station.

Now, given this phenomenon, it is easy to understand how a trackside wireless station, using a horizontal antenna wire, say, 100 ft. long, fastened to two or three telegraph poles can communicate with another trackside station similarly arranged, and distant 20 or even more miles from the first.

Obviously, one or both of these stations can be located on board a train, and in such case the horizontal antenna wire can, as I have demonstrated, be run inside the cars, of heavily insulated wire, parallel to the bell cord. This is, of course, providing that the cars are of wood and not of steel. In the latter case, wires would need to be supported on insulators a few inches above or at one side of the roof of the cars.

* Abstract of a paper read before the Association of Railway Telegraph Superintendents of America.

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By this arrangement it would be a comparatively simple matter to telegraph regularly to and from express trains, over a distance of, say, 40 miles (20 miles on each side of the trackside station). However, the commercial applications of such a wireless telegraph service would be generally confined to a few limited trains, where for the benefit of travelling business men, a news or stock report service could be made a feature. The expense of carrying a telegraph operator on board more than the cost of the equipment entailed, would greatly limit such application.

With the radio telephone, however, the case becomes very different, so different, in fact, that it is my firm belief that ere many years the telephoning to moving trains, and especially to locomotives, will become a very common, or well-nigh universal adjunct to our elaborate railroad safety appliances.

For such a purpose, long distance of communication will be quite unnecessary, in fact, undesirable. Consider a railroad system equipped with the block system, with signal stations or towers at mile intervals; a small wireless telephone transmitter capable of half-mile communication and utilizing the inductive or "wave-chute" action of the existing telegraph wires would cost little to instal, little to operate, and be so simple as to add practically nothing to the training of the signal operator. A horizontal antenna wire would be extended to the first or second telegraph pole stretched three feet below the lowest telegraph wire, the earth connections would be direct to the track rails. On the locomotive or over the locomotive and the first coach will extend an insulated wire as easily coupled up when making up the train as is the air brake at present. In the cab a small box is fastened containing a tuning coil and a simple crystal wave detector; connected to this is a single head telephone receiver with headband attached, or a telephone receiver with rubber air pad is fastened to a short arm, at a point where the engineer can easily rest his ear against it. The body of the locomotive, of course, supplies the earth connection.

This system would enable the signal man to talk direct to the engineer for a period of one to four minutes, and add immensely to the probability that he will perceive the proper signal, or enable him to receive orders or information which the semaphore cannot possibly communicate. The engineer could reply only by whistle.

It would appear that by this appliance it will be generally quite unnecessary for a train to stop merely to receive dispatcher's orders. What value this saving of time of hundreds of trains would aggregate to the railroads in a year, I have no means of estimating. Surely it would total very large figures.

Arrangements have already been made with the New York Central for carrying out a series of experiments in telephoning thus to moving trains, from a trackside station at Spuyten Duyvil, on the Hudson; and I expect soon to be able to publish some very interesting results.

A short-range wireless telephone transmitter for such service as I have just described is operated from a few cells of Edison-Lalande battery, and the entire transmitting outfit will occupy less than three cubic ft. of space.

Now consider the application of such wireless telephone instruments to freight train service, on roads like the Santa Fe, for example, without block signal stations at short intervals.

It frequently happens that a train awaits on a siding for long periods the passing of another which has been delayed by accident or other cause and with no means whereby the train crew can be notified to proceed. A portable telephone set installed in the caboose could be quickly brought into action to call up the nearest dispatch station.

To facilitate this work a length of flexible antenna wire can be very quickly spiked up on two or three telegraph poles as high as a man can reach, parallel to the telegraph wires or directly connected to a wire through a small condenser, the capacity of which is too small to allow any detrimental grounding of the wires. This "emergency antenna" can be strung up and taken down again in two minutes' time. Such means for getting quick communication with stalled freights will mean an immense saving in costly delays to freight and to all trains affected by the tie-up, to say nothing of loss in wages to idle train crews.

I believe that the railroads will soon see this method demonstrated, and be quick to admit the economy to them of equipping every caboose or a car on every accommodation train with such portable wireless telephone transmitting and receiving sets, whether or not the locomotive carry the receiving apparatus described above.

Ideas as to the possibilities of our land wireless telegraph for commercial purposes have been generally founded on the all-too-plainly demonstrated failures and shortcomings of the spark systems. Such service is limited to relatively short distances over land by daylight, on account of the sad inefficiency of the spark wireless transmitter. The best of the spark systems can radiate generally less than 10 or 12% of the energy taken from the dynamo, then the trains of electric waves which the spark transmitter sends out are strongly damped. Sharp tuning at the receiving station to cut out interference from other stations or from atmospheric causes is really quite impossible when one has to work with these strongly damped waves from a spark transmitter.

Hence, in addition to the short ranges necessitated, the spark system is not, and cannot be made reliable and "interference-proof." Such means, therefore, as supplementing the wire service of a railroad at times of emergency, as when long stretches of wire are mowed down by sleet and wind storm, is quite impracticable because so altogether unreliable.

During the last year, however, a new epoch in wireless telegraphy has been entered, marked by the "Radio-tone" transmitter (as it is called), which is sparkless and noiseless. In place of the noisy, crude and inefficient old spark gap, it employs a silent discharge from the antenna wires and emits trains of waves which are only very slightly damped.

Moreover, we can now radiate 50 to 75% of the energy derived from the alternating-current dynamo instead of the 10 to 12% of the spark system. This means that ranges two or four times greater than those given by the old spark method are possible, and that wireless interference from natural or artificial sources can be completely and successfully eliminated.

I have a photograph taken in San Francisco of a 2 kw. installation of the sparkless radio-tone system on board the United States Army transport "Buford." The first day this apparatus was put in operation the "Buford," lying at her wharf in San Francisco, communicated in bright daylight with a naval station at Point Aguillos, nearly 300 miles south, a new daylight record on the coast. A number of other army transports are now being equipped with this system, replacing the spark apparatus.

The art has now actually reached the stage where we can begin to handle overland business in competition with wire lines.

Therefore, the sparkless wireless telegraph possesses immediate interest to railroad telegraphers as ready means for communicating over long distances between division headquarters, especially at times of emergency when storms and washouts have cut wide gaps in the wire system.

I foresee this use of the wireless telegraph coupled with short range telephone safety signalling and emergency service as occupying a very extensive field of usefulness to railroads and the travelling public.

RADIO-TELEGRAPHY PATENTS.

The case of Mr. Marconi and the Marconi Wireless Telegraph Company *v.* the British Radio-Telegraph Company was opened in the Chancery Court before Mr. Justice Parker. The plaintiffs seek to restrain the defendants from infringing three patents, the first of which is known as the "four sevens," No. 7,777 of 1900. The other two are patents of 1902 and 1907. Report will appear in due course.

ELECTRICAL ENGINEERS TERRITORIALS (London Division).—Orders for week ending December 24, 1910: Officer commanding, Col. H. M. Leaf. Monday, December 19, "A" Co., Technical Drill, 7 to 10 p.m.; Tuesday, December 20, "B" Co., Technical Drill, 7 to 10 p.m. Headquarters will be closed for the Christmas holidays from December 21 to January 4, 1911, both days inclusive; the Orderly Room will be open on week days from 10 a.m. to 4 p.m., except on Saturdays and Bank Holidays, when it will be entirely closed. (Signed) P. H. Campbell, Capt. R.E., Adjutant.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

DUNGIVEN.—It has been decided to substitute electricity for oil as an illuminant within the town. At a public meeting Mr. Alexander Semple, J.P., submitted in detail a scheme which satisfied the meeting that he was in a position to provide an abundant supply of electricity for the private lighting of the town. He proposed to generate the current at his mill premises, where he would instal an adequate plant, there being a plentiful supply of water for the purpose. A general discussion ensued, after which it was unanimously resolved to approve of the scheme as explained by Mr. Semple.

FELIXSTOWE.—The Suffolk Electricity Supply Company, Ltd., at the suggestion of the Town Council, have agreed to reduce the price for current from 6½d. to 6d. per unit, for prompt payment. The company hopes that as soon as the benefits derived from improvements at the works have been realised, and the depreciation caused by the general adoption of metallic filament lamps has ceased, it will be possible to make a further reduction.

FOLESHILL.—Messrs. Merry and Cunninghame, of Binley Colliery, have been granted permission to carry an overhead cable across Willenhall-lane.

GRANTOWN.—The question of public and private lighting is now before the town. Councillor Anderson, who generates electricity for his own business purposes, has put up several experimental street lamps, and offers to supply electricity, both for public and private lighting, at a low rate. He would either form a small company to run the undertaking, or retire from the Council and run the concern himself.

HEBDEN BRIDGE.—Alterations to the accumulator batteries are to be carried out, and the Town Council's electricity regulations are to undergo modification.

HOUNSLOW.—The extension to the Heston and Isleworth District Council's electricity works, which has been carried out at a cost of about £3,000, has now been opened. The new plant includes a Browett Lindley engine and a British Westinghouse generator of a capacity of 250 kw. The capacity of the works has thus been doubled.

MONMOUTH.—It has been decided that after April 1 next the electricity department will charge the Corporation 2d. per unit for pumping at the sewage works. An extraordinary motion has been adopted by the Council to the effect that users of motors should be notified not to use current for motor purposes after lighting up time. This would seem to place a very serious limitation on the utility of electricity for power purposes, and certainly requires some explanation.

NEWQUAY.—The Newquay Electric Light Company have raised objections to the Urban Council granting permission to the Hotel Victoria Company carrying a cable for the supply of electricity from the hotel to their garage at Springfield, but the permission given is to be maintained.

TIPPERARY.—The Board of Guardians are about to instal electric lighting throughout the workhouse, as well as a power laundry.

TODMORDEN.—A movement is on foot to induce the Town Council to extend their electric mains. Their generating plant is of a far higher capacity than the present output, and it is held that if the mains were extended in certain directions, a steady rise in demand would be secured.

WEST HARTLEPOOL.—A Local Government Board enquiry is to be held into an application by the Council for permission to raise a loan for electric lighting extension.

WILLENHALL.—An agreement has been signed between the District Council and the Midland Electric Corporation for Power Distribution, Ltd. The latter undertake to put up four lamps in the Market-place, and to light them free of cost for five years.

OVERSEAS.

BOMBAY.—The Tata Hydro-Electric Company is already meeting with certain difficulties. For instance, the municipality of Lonauli are raising objections to the construction of the mo: soon lake at that place.

LAZIO, ITALY.—The Società Laziale di Elettricita have obtained from the Prefecture of Lazio powers to supply the communal districts of Palombara, Montecelio, Monterotondo and Mentana with electric light.

MELBOURNE.—Strong efforts are being made to induce the City Council to reduce the price of electrical current used for motive power. At present the Melbourne Electric Supply Company charge more for current for illuminating than does the city, while it charges much less for power than the city. The position is held to be anomalous, and inimical to electrical progress, as well as to the prosperity of the city undertaking.

TORONTO.—Mr. W. Randolph Sweany, business manager of the hydro-electric power service, promises consumers a saving of 40 per cent., as compared with the existing private company's rates. Negotiations still proceed for the purchase of the company's plant by the city, so as to avoid a costly competition, with loss to the shareholders.

TRACTION.

HOME.

DERBY.—The Corporation are spending £152 15s. on meters for their tramcars.

DUDLEY.—Much dissatisfaction is expressed at the arbitration award as to the charge for electricity by the Corporation to the tramway company. It is said that the new rates will mean a reduction of about £1,000 a year to the Electricity Department. This, however, will be partly remedied by the increased amount received from the company for the new lease of the tramway.

WEST HARTLEPOOL.—Steps are being taken as regards arbitration on the question of the purchase of the tramway company by the Corporation.

OVERSEAS.

OPORTO.—The Companhia Carris de Ferro do Porto have applied to the "Inspeç ao Geral dos Telegraphos e Industrias Electricas" for powers to construct an electric tramway between the Estrada da Circunvalla ao and Venda Nova, in Oporto.

ROME.—The Società Anonima delle Tramvie e Ferrovie di Roma have recently been granted a 50 years' concession for the construction and working of an electric tramway from Rome to Albano.

COMPANIES' MEETINGS AND REPORTS.

MORECAMBE TRAMWAYS.

The annual meeting of the shareholders in the Morecambe Tramways Company was held on Saturday at the Crown Hotel, Morecambe, Mr. W. H. Pickles (chairman) presiding. The Chairman, in moving the adoption of the balance-sheet, stated that the receipts from fares had increased £241 5s. 5d., and there had been an increase in the number of passengers of 28,736. The receipts showed an increase of 3.23d. per mile, and the working expenses 1.72d. per mile. Royal assent had been obtained to the company's bill to employ motor traction in place of horse traction, and also to return to the shareholders a proportion of the purchase money paid to the company by the Morecambe Corporation for that portion of their undertaking within the borough. The directors recommended the payment of a dividend at the rate of 2% in the past year's working.

Mr. H. Waters (Morecambe), in criticising the balance-sheet, said the company's capital was being whittled down to foster a doubtful scheme of motor traction. He considered that a poll of the shareholders would be found against the proposition. Motor traction might be in the interest of the public, but they, as shareholders, had to consider themselves and not the public.

The balance-sheet was approved by one vote.

INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS COMPANY.

The report for the year ending September 30 states that after provision for doubtful debts, there is a net profit of £55,414 8s. 5d. Adding £55,011 16s. 2d. brought forward, and deducting £4,687 10s., the dividend on the Preference shares paid in January and July, and £12,500 the dividend on the Ordinary shares paid in July, there remains a disposable balance of £93,238 14s. 7d., which, after providing for the balance of the dividends proposed for the year, and a special reserve of £30,000 set against stocks, will leave £22,613 14s. 7d. to be carried forward. The directors recommend that the payment of the half-yearly dividend of 5s. per share, or at the rate of 5 per cent. per annum, be made to the Preference shareholders on January 1, prox., and they further recommend

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the distribution of a dividend to the holders of Ordinary shares of 15s. per share, free of income tax, amounting to £37,500, making, with the interim dividend paid in July, a total payment of 10 per cent. for the year. The general business of the company shows an increase compared with the turnover of last year, which is, however, partly due to the higher scale of prices at which some of our goods have been sold. Taken as a whole our foreign agencies have done a profitable business, and the sales of our home agencies have been satisfactory. The prices of some raw materials attained an abnormally high level, but the advances we were able to make in the selling prices of our goods have, except in the case of our French works, sufficiently met the situation. Our stocks, however, are highly priced and the Board have thought it desirable to make the provision mentioned in the first paragraph. The expenditure at the French works to increase the facilities there is not yet completed, but will be during the current year. There has been an increase in the submarine cable work during the year, and the steamer "Buccaneer" has had fair employment.

THE BRITISH COLUMBIA ELECTRIC RAILWAY.

The annual report states that for the 12 months to June 30 last the gross receipts show an increase of $730,492, or 31%, and the net earnings, including income from investments and subsidiaries, and after charging renewals, show an increase of $176,341, or 19%, over the preceding year. From June 30, the close of the financial year under review, up to October 31 last, there has been a still further increase in gross earnings of $279,950, or 29%, and in net earnings of $77,281, or 17%. The following charges have been made against the revenue account of the year, viz.: Provision for renewals maintenance (from which £15,242 4s. 2d. has been deducted for adjustments and expenditure on renewals during the year), £46,425; special provision against depreciation in value of certain obsolete steam plant, £3,000; bonus to employees, £11,333; amount added to capital amortisation fund, £2,098. The net profit for the year, after making the above deductions, amounts to £198,869, which, with the balance brought forward from last year, makes £205,930. Deducting interest on debentures and debenture stock to June 30, 1910, £59,478, and the dividends already paid on 5% cumulative perpetual preference stock for the year ended June 30, 1910, on preferred ordinary stock for the year ended June 30, 1910, and on deferred ordinary stock for six months to December 31, 1909, there is left available for further distribution and reserves £67,452.

From this the directors have decided to recommend the payment of a dividend on the deferred ordinary stock at the rate of 8% per annum for the six months to June 30, 1910, making 8% for the year, absorbing £24,000, to transfer to reserve fund £37,845, and to carry forward to next account £5,606. There has been deducted from the reserve fund the sum of £18,531, representing the difference between the net amount realised by and the par value of £530,000 4½% debenture stock, issued in February last, and there has been added to the reserve fund, £39,584, representing the premium on £500,000 new capital, less expenses, issued in September, 1909. After the transfer now recommended by the directors, as above, the reserve fund will amount to £235,000. The number of lamps in use at June 30, 1910, was 439,315, an increase for the year of 92,289. The number of passengers carried during the year was 34,476,804, an increase for the year of 9,293,065.

The commercial conditions at present existing in Vancouver, it is added, and the prospects for the future, have been carefully examined by the directors, who are pleased to report that the information at their disposal, obtained from reliable sources, indicates the existence of a sound basis for the undoubted prosperity which at present prevails throughout the whole province, and gives promise of its continuance in the future.

MELBOURNE ELECTRIC SUPPLY.

The annual report for the year ended August 31 states that during the year, capital expenditure in Australia on additional land, buildings, plant and mains, &c., has been incurred as follows:—On the Melbourne undertaking, £43,567 16s. 5d.; on the Geelong undertaking, £6,338 11s. 11d.; or a total of £49,906 8s. 4d. The profit and loss account shows that the gross profit derived during the year from the Melbourne and Geelong undertakings was £21,302 5s. Adding the dividend received on the company's holding of ordinary shares in the Adelaide Electric Supply Company, Ltd., together with discounts, transfer fees, &c., the total gross profit for the year amounts to £28,428 13s. 9d., which compares with £29,733 7s. 7d. for the previous year. After payment of management and general expenses at the London Head Office, and interest on debenture stock, there remains a balance to the credit of profit and loss account of £13,674 12s. 1d., to which must be added the amount of £3,694 9s. 3d. brought forward from the previous year, making a total credit balance of £17,369 1s. 4d. Deducting from this sum the dividend on the first preference shares for the half-year ended February 28, 1910, there remains an available balance of £13,869 1s. 4d., which the directors recommend should be applied as follows:—Dividend on 20,000 seven per cent. first preference shares to August 31, 1910 (paid on September 1, 1910), £3,500; transfer to depreciation and general reserve account, £5,000; writing down suspense account, £1,966 9s. 6d.; writing down head office furniture, £50; leaving a balance to carry forward of £3,352 11s. 10d.; total, £13,869 1s. 4d. During the year a further 7,750 Adelaide ordinary shares have been sold at a profit of £1,033 10s. 6d., this profit being applied in reduction of suspense account. Since the last annual general meeting, the directors have devoted further attention to the question of dealing with the arrears of dividend on the £150,000 six per cent. cumulative preference stock, amounting at August 31, 1910, to £80,950. A definite scheme has now been prepared, which has been approved in principle by a number of the principal preference stockholders; and it will be submitted for adoption to extraordinary general meetings of the preference stockholders and ordinary shareholders to be held immediately prior to the annual general meeting on the 21st inst. The serious and prolonged coal strike which broke out in Australia about a year ago, involved the company in heavy extra expense in the purchase of fuel, the effect of which is reflected in the revenue accounts, and is responsible for the check in the hitherto steady annual increase in the gross profit earned at Melbourne. A contract has been made for the supply of electric power from the Melbourne station to the Prahran-Malvern Municipal Tramways Trust. The supply was commenced in June last, and is being maintained satisfactorily. Extensions of the tramways are already in progress, and will involve an increased demand for power. Orders-in-Council for the supply of electricity in the suburbs of Brighton and Camberwell have recently been granted to the company; and distributing mains are being laid in these districts. Negotiations are proceeding with the Town Council of Hawthorn for a lease of their Order-in-Council, with a view to the inclusion of this important and hitherto untouched district in the company's sphere of operations. An agreement has been entered into with the local authorities at Geelong for the establishment of a small system of electric tramways in the town. The work of construction is proceeding and it is expected that the tramways will be opened for traffic in the course of 1911. The necessary power will be supplied from the company's existing generating station at Geelong, which is well adapted for the purpose. The Adelaide Electric Supply Company, Ltd., has continued to make excellent progress during the year, and a dividend at the rate of 7% on the ordinary shares, together with a bonus of 2s. per share was declared and paid on the 5th inst. in respect of the year ended August 31, 1910, credit for which has been taken in this company's profit and loss account.

COMPANIES REGISTERED.

ANGLO-FOREIGN TRAMWAY SYNDICATE, LTD.—£10,000, in 9,500 Pref. shares of £1 each and 5,000 "A" and 4,000 "B" and 1,000 Ord. of 1s. Electra House, Finsbury-pavement, E.C.

BRITANNIA IMPORT COMPANY, LTD., ELECTRICIANS, &c.—December 1. £500, in £1 shares. 87, Tabernacle-street, E.C.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

CONTRACTS OPEN.

HOME.

BARKING TOWN.—The Urban Council invite tenders for the supply and erection of (A) 400 kw. Diesel engine and dynamo; (B) 250 kw. motor generator; (C) traction battery and reversible booster; (D) main switchboard and connections; (E) overhead travelling crane. Particulars from the Municipal Electrical Engineer, Barking, Essex. December 20.

LLANDUDNO.—Urban Council invite tenders for (a) Motor-driven induced draught plant; (b) mechanical stokers for one Lancashire and one Babcock boiler. (Particulars from Engineer, Electricity Works.) December 24.

LONDON, E.—East Ham Corporation.—Section A.—One 1,000 kw. triple-expansion medium-speed engine and generator, complete. Section B.—One evaporative condenser for 40,000 lb. of steam per hour, with air pumps, circulating pumps, piping, valves, connexions, and auxiliaries. Particulars (£2 2s.) from Engineer and Manager, Tramway Depot, Nelson-street, East Ham.) December 30.

OVERSEAS.

ADRIANOPLE.—The Turkish Ministry of Public Works invite tenders for a concession for the construction and working of electric tramways in Adrianople, and for a concession for the provision of electric light in the Sandjak of Adrianople. The concessionaire will have the right to erect hydro-electric works on the banks of the rivers Maritza, Arda and Tundja Tenders, which will be opened on March 15, should be addressed to "Monsieur le Ministre du Commerce et des Travaux Publics," Constantinople. Local representation is essential in the case of Turkish Government contracts.

CONSTANTINOPLE (Extension of Time).—The Municipality invite tenders for the construction and working of electric tramways in Constantinople and suburbs. Extension from November 10 to December 20.

INVERCARGILL, NEW ZEALAND.—The Corporation invite tenders for the supply of an electric trolley-system of tramways. The contract is divided into the following sections:—Power house plant; rails, fishplates and bolts, points and crossings, special work and bonds; car bodies; electric car equipment; car trucks; overhead material; wires and cables; steel poles; tower wagon; dog spikes; street lighting plant. Tenders, which will be received up to 4 p.m. on January 9, 1911, should be addressed to the Town Clerk, Invercargill, New Zealand. The specifications may be seen at the offices of Messrs. W. Coward & Company, 91, Finsbury-pavement, London, E.C., and of Messrs. A. Dickinson & Company, 219, Gresham-house, Old Broad-street, E.C., and Central-house, New-street, Birmingham. Copies may be obtained at the same addresses on deposit of £1 for each section, which deposit will be returned upon receipt of a *bona-fide* tender.

JERUSALEM.—The Municipality invite tenders for (2) electric tramways and electric lighting installations in the town; (4) telephone installation at Jerusalem, Jaffa and Bethlehem. Tenders in respect of each of the above schemes will be received by the municipal authorities up to December 31. Local representation is desirable.

PERTH.—Tenders are invited by the Minister of Public Works of Western Australia for the supply, delivery, and erection of electrical pumping machinery (Contract No. 75). Tenders will be received by the Hon. the Minister for Works, Public Works Office, Perth, Western Australia, up to February 28, 1911. Copies of the condition of contract, etc., may be obtained, on payment of £1 1s., from the Contractor's Room, Public Works Office, Perth, Western Australia.

SYDNEY.—The Deputy Postmaster General will receive up to 2.30 p.m. on February 1, 1911, for the supply of a testing equipment, consisting of rotary convertor, transformer, switchboard, etc. (Schedule No. 59.) A deposit will be required with each tender. Local representation is necessary. Note.—For copies of the specifications and forms of tender in regard to each of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria Street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London. E.C.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

TAIHAPE, NEW ZEALAND.—Tenders are invited by the Taihape Borough Council for the supply and erection of a hydro-electric lighting and pumping plant. Tenders, marked "Tender for Electric Plant," will be received by the Town Clerk, Taihape, N.Z., up to 5 p.m. on January 11, 1911. A deposit of £130 must accompany each tender.

OSRAM·LAMPS

TENDERS ACCEPTED.

BRIGHTON.—Messrs. Siemens Bros. Dynamo Works, Ltd., have secured the annual contract for street lighting with their 50 c.p. "Onewatt" lamps.

BRISTOL.—The Corporation Electrical Committee have entered into the following contracts in connection with the provision of offices, showrooms, etc., at the Exchange:—F. and W. Bracher, lighting, heating, etc., £102 10s.; John Perkins & Sons, Ltd., painting and decorating, etc., £498.

LONDON.—L.C.C. Overhead equipment Putney-bridge to High-street. Clough, Smith & Company, Ltd., London, E.C. (recommended).

RAWTENSTALL.—Town Council. Six single-deck tramcars, with complete equipment. United Electric Car Company, Preston, bodies and trucks; Siemens Bros. Dynamo Works, equipment.

WALSALL.—Electricity Committee. Supply and erection of boiler. Babcock & Wilcox, Ltd., £1,189 6s. (recommended); Underfeed Stokers. Underfeed Stoker Company, £267 (recommended).

WIGAN.—Town Council. The General Electric Company, Ltd., for the scrap battery at the electricity works; W. T. Glover & Company, Ltd., for the supply and laying of cables in Wigan-lane to the Boar's Head Pumping Station, and the supply of cables for stock; P. R. Jackson & Company, Ltd., for the conversion of two feeder-boosters from 20 to 75 volts.

OPENINGS FOR TRADE.

Plant, Wiring, Fittings, Accessories, etc.

CENTRAL STATION EXTENSIONS, ADDITIONS AND PROJECTS.

Agreed upon.

TOWN COUNCILS.

Bedford: Extension of Mains.
Bradford: Extensions to Cables—£4,000.
Bacup: Mains, etc.—£3,000.
Gillingham: Extensions—£3,500.

Contemplated.

Eastbourne: Extensions—£8,000.
Winchester: Extensions.
Woolwich: Extensions—£3,000.
Haslingden: Electricity scheme—£5,000.
Halifax: Extensions, tramways.
Walsall: Extensions, mains—£1,150.
Bradford: Extensions—£60,000.

Agreed upon.

URBAN DISTRICT COUNCILS.

Erith: Extensions—£10,000.
Leyton: Electricity works—£7,000.
Broadstairs: Flame arc lamps.

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Contemplated.

Axminster: Electricity works.
Maidstone: Electricity works—£4,000.
Trowbridge: Electricity works.
Felixstowe: Electric lighting—£3,000.

Constructional and other work will shortly be carried out by or for the following authorities or firms. The amount mentioned is the contract price in each case.

Blackburn: R. Gradwell, architect. Church.
Braintree, Essex: F. Willmott. Ilford school, £1,623.
Deptford, S.E.: Messrs. Thurgood, Son & Chidgey, 8, Adelphi-terrace, London, W.C. Police station.
Derby: D. Gill & Sons. Doncaster sorting office.
Eye, Suffolk: Gayford. Grammar school, additions, £2,832.
Kirkcudbright: D. Meikle, Ayr. Drill hall, £3,000.
Bushey, Herts: Norris & Sons. Sunningdale Parochial hall, £1,792.
Stirling: R. D. Gardner, builder. Offices.
Pitsea, Essex: F. W. Bittles, Clerk to the Committee, Brentwood. Elementary school.
Newbottle: Secretary, Newbottle and District Co-Operative Society, Ltd. Rebuilding part of the Stores.
Great Harwood: Wright & Son, surveyors, Lancaster. Church.
Watford: H.M. Office of Works, Storey's-gate, Westminster. Extension of County Court.
Bingley: W. R. Nunns. Temperance hall and Institute.
Llandilo: W. L. Jenkins, County Surveyor. Police and Court house at Ammanford.
Newton Abbot: Board of Guardians. Additional wards at infirmary.

NOTES.

Decorative Outfits.

The Electrical and Engineering Supplies Company, Ltd., who are makers of electrically illuminated wooden letters for signs and also of motor-driven automatic sign flashers, have placed on the market diminutive electric lamp decorative outfits. The small lamps, either globes or little candles, are supplied attached to flexibles, all live parts being entirely enclosed, and can be readily fitted up. These outfits are suitable for Christmas tree and other interior decorations, as well as shop window display. The lamps are supplied clear, obscured, red, blue and green. While specially appealing to buyers at this season, the outfits should be in demand for festivities all the year round. Copies of the illustrated circular can be obtained from the Electrical and Engineering Supplies Company, Ltd., 36 and 37, Upper Thames-street, E.C.

Push-Button Switches.

Push-button switches, with action either into the "on" or "off" position, are more and more required for "remote control" purposes, as well as controlling lifts, printing presses and many other appliances. To meet this want, Messrs. A. P. Lundberg & Sons have brought out their "Reliable" push-button "Pivot" switch, made in both 5 and 10 ampere capacities, and (1) with contact arm in "off" position until pressed, (2) with contact arm in "on" position until pressed. The movement is of the firms well known "Pivot" switch action, with variable leverage, in sliding engagement with a push button. The appliances are well made and easily worked. We may mention that Messrs. Lundberg have brought out a new list, S. 26, on "Pivot" tumbler switches, and a revised list, S. 25, of their "Pivot" intermediate switches.

Tantalum Lamps and Holophane Reflectors.

Messrs. Siemens Brothers Dynamo Works, Ltd., have brought out a booklet dealing with "Tantalum" electric lamps in combination with holophane reflectors and fittings. This combination, used to obtain a perfect diffusion of light, has received considerable attention at the hands of the electrical fittings manufacturers, and, judging from results, there is no doubt that it provides a very effective means of illumination. The booklet, which will be supplied to contractors, gives details and illustrations of a variety of installations in which "Tantalum" and "Onewatt" lamps figure in conjunction with holophane glassware, different types of holophane reflectors and fittings being used. They are all good, and some of them quite artistic.

Reflector Fittings.

We would call our readers special attention to the weatherproof and effective reflector electric lamp fitting put on the market by the Benjamin Electric, Ltd. Our

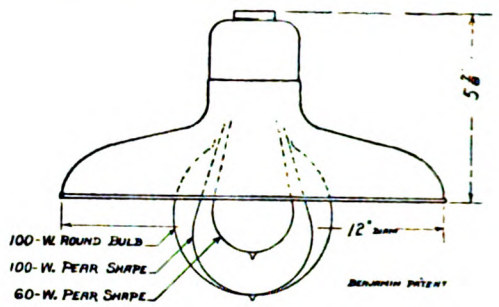

diagram shows that these are applicable to both small and large lamps of any shape. It will be seen that these reflectors not only utilise the light to the best advantage, but protect the lamps. These should prove an easy selling line for dealers.

Osrams on a Bowling Green.

Readers will perhaps remember that some time ago we referred to the use of electric lamps for bowling greens. It now appears that an enterprising hotel keeper in Redditch has done the very thing that we suggested, and is illuminating his bowling green by means of high candle-power "Osram" lamps to enable patrons to continue their play after dark. The idea thus put into effect has, we understand, proved a very popular one. Ample light for the purpose is obtained by means of five 200 c.p. "Osram" lamps, suspended from bracket arms attached to scaffold poles, one at each corner of the green, and one suspended from centre of steel wire stretched right across. The wire is carried round the sides of the green on insulators and controlled by a DP switch and fuses fixed by the door leading from the hotel. The green, which measures 45

yards by 25 yards, is extremely well illuminated, and we understand that the proprietor of the hotel and also other members of the club are more than satisfied with this experiment. Their approval is also supported by the fact that whenever the weather has been favourable, not only general bowling, but also handicap games and matches have been played until as late as 11 o'clock in the evening. In view of the exposed position and somewhat trying circumstances under which these lamps are working, this installation furnishes excellent testimony as to the robust nature of the "Osram" filament, and amply justifies the maker's claim for these lamps that they are adaptable to almost any style of usage. The installation was carried out under the direction of the Redditch Electricity Works.

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"Stannos" Wires.

Amongst the numerous installations which have been recently carried out with "Stannos" wire, the following are worth mentioning:—Messrs. Baxter & Impey, Birmingham, have carried out the installation of a large country house at Knowle, Warwickshire. Messrs. J. H. Harpin & Company, Birmingham, have put in a complete installation of four Siemens motors with "Stannos" wiring for Richard Cooper & Sons, Atlas Works, Wolverhampton, and have also put in "Stannos" in country houses at Cobham, Surrey, and Burton Point, Cheshire. Messrs. E. D. Wishart, Southampton, are carrying out for Siemens Brothers the installation of a new theatre at Eastleigh, consisting of a 15 h.p. gas engine, "Stannos" wiring and "Zed" fuses. This firm are also carrying out the wiring of Summers & Payne's yacht-building yard, to the order of Siemens Brothers.

Crypto Extension.

Owing to the rapid expansion of their business, the Crypto Electrical Company have found it necessary to again enlarge their factory, as they have completely outgrown their present accommodation, despite the fact that they made an addition just over a year ago of about 50% to the then available space. The firm have during the last six years found it necessary on four occasions, either by moving into a larger factory or by taking adjoining premises, to increase their factory.

DIARY.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, at 8 p.m., Prof. H. C. H. Carpenter and Mr. C. A. Edwards, on "The Production of Castings to Withstand High Pressures."

SATURDAY, DECEMBER 17.

JUNIOR INSTITUTION OF ENGINEERS.—Visit, 3 p.m., General Post Office New Power House, Upper Ground-street, Blackfriars, and sub-stations in connection.

MONDAY, DECEMBER 19.

BOROUGH POLYTECHNIC INSTITUTE.—Borough-road, S.E. Distribution of Prizes and Certificates by the Earl of Lytton.

INSTITUTION OF ELECTRICAL ENGINEERS (Newcastle Section).—In the Armstrong College, Newcastle-on-Tyne, Mr. H. W. Clothier will open a discussion on "Switchgear and the Isolation of Faults on Power Systems."

TUESDAY, DECEMBER 20.

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science, South Kensington, from 3 to 6 and 7 to 10 p.m., Dr. J. A. Fleming will give an experimental discourse on Detectors.

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Section).—Physical Laboratory, University, at 7.30 p.m., K. Faye-Hansen and G. Harlow on "Merz-Price and other Discriminative Protective Apparatus for A.C. circuits."

PHYSICAL SOCIETY OF LONDON.—At the Imperial College of Science and Technology, South Kensington, annual Exhibition of Electrical, Optical and Physical Apparatus.

SATURDAY, DECEMBER 31.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (South Wales Branch).—At the Hotel Metropole, Swansea, 3.30 p.m., discussion to be resumed on "The Inspection and Repair of Electrical Plant Underground," by Mr. R. R. Smith.

FINANCIAL NOTES.

WINNIPEG ELECTRIC RAILWAY.—A quarterly dividend of 2½% has been declared, payable on January 2 to shareholders on the register on December 15.

* * * *

CANADIAN GENERAL ELECTRIC.—A quarterly dividend of 1¾% is announced on the common stock.

* * *

SURFACE CONTACT.—We are informed that the American Surface Contact Company has been incorporated in New York with a capital of $250,000 to acquire the American and Canadian rights of the S.P. (Surface Contact System) Syndicate, Ltd., 88, Fenchurch-street, E.C.

THE BATTI-WALLAHS.

The Birmingham Section of the P. & O. Batti-Wallahs' Society held their second function of this season under the chairmanship of R. A. Chattock, Esq., the city electrical engineer and manager, on the 2nd at the Grand Hotel, Birmingham. On this instance a very successful ball was given. Care had been taken not to over-crowd the magnificent Grosvenor Room, but there were sufficient to make the evening a very pleasant and enjoyable one. A good and acceptable supper was provided at the interval, and some 130 ladies and gentlemen sat down. At the conclusion, the Chairman, who was heartily received, remarked that it was not usual to make speeches at suppers of this kind, but the Batti-Wallah's always did things out of the common, and he could not let this opportunity go by without saying how pleased he was to see so many friends round him, and asked them to rise and drink to the health of our King, King George V., which was heartily responded to with musical honour, the solo by Mr. H. Foulds. Of course, the ball once started rolling, it was impossible to pass over the ladies without some mark of favour, which was very ably done in true Batti-Wallahs' style by Mr. E. T. Davies. This toast was also well received, also with musical honours, and, of course, our past Chairman and present Vice-Chairman could not be left alone, and none were satisfied until he had been brought to his feet. Their next function is a smoking concert on January 19, 1911.

METROPOLITAN ASSOCIATION OF ELECTRIC TRAMWAYS MANAGERS.

A meeting of the members of this association was held on Friday, December 9, 1910, at the Municipal and County Club, Whitehall-place, Whitehall, S.W., when there were present:—Messrs. H. E. Blain (West Ham), A. G. Balfour (Dartford), A. Coveney (Erith), H. L. Howard (Barking), C. Mittelhousen (Bexley Heath), F. Schofield (Leyton), W. C. Ullmann (East Ham), W. E. Hammond (Met. Electric), A. V. Mason (South Metropolitan), T. B. Goodyer (Croydon).

Messrs. A. H. Stanley (London United) and W. Murray (Walthamstow) were unavoidably absent. Mr. A. H. Stanley was unanimously elected chairman; Mr. H. E. Blain, vice-chairman, and Mr. T. B. Goodyer, hon. secretary for the ensuing year. It was reported that the work in connection with the formation of the Central Claims Bureau was proceeding most satisfactorily, and that there was every hope that the Bureau would come into existence early in January next.

PERSONAL.

Mr. F. B. O. Hawes, A.M.I.C.E., A.I.E.E., has resigned the managing directorship of the Langdon-Davies Motor Company, Ltd., though he becomes consulting engineer to that company. This change is owing to the large increase of work in the carrying on of the National Electrical Manufacturers' Association, and other work with which he is connected.

We much regret to announce the death of Mr. James R. Barr, A.I.E.E., who was to have read a paper before the Glasgow section of the Institution on Tuesday last.

Mr. W. H. Clegg, A.M.Inst.C.E.I., who has been with the Edison & Swan United Electric Light Company, Ltd., as district superintendent at their Leeds depot for the past three years has resigned to take up the position of commercial and sales manager of the Adams Watkin Company, Ltd.

Mr. V. J. Allan, shift engineer, Kent Electric Power Company, Frindsbury Power House, Strood, Kent, has resigned, to take up the appointment of shift engineer at Southampton Corporation Electricity Works. Mr. E. E. Hamar succeeds Mr. Allen, and Mr. F. W. T. Bradley has been promoted to Mr. Hamar's position.

Messrs. Dorman & Smith have appointed Mr. F. A. Leonard as their representative for Lancashire, Yorkshire, Cheshire, Derbyshire and Nottinghamshire.

Messrs. Royce, Ltd., electrical crane makers, Trafford-park, Manchester, have appointed Mr. F. E. Chilton as their manager for London and district. Their London office is now at 13, Walbrook.

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PATENTS.

Producing Sound Waves for Signalling.

17770.—1909. W. D. Kilroy, J. C. Needham, Eversheb & Vignoles, Ltd., Acton. The invention consists of a wave originator in which a diaphragm is adapted to be vibrated positively in both directions by direct and alternating current. An electro-magnet gives differential or added fluxes.

Electrically Operated Planing Machine Tools.

22234.—1909. Lancashire Dynamo & Motor Company, Ltd., and G. E. Mason, Didsbury. The apparatus comprises a driving motor geared to the reciprocating part of the tool, a generator driven by a motor (the armature of the generator being connected in series with the armature of the driving motor) and a switch actuated through adjustable tappet gear on the reciprocating part and adapted at the end of each stroke to reverse the connection of the field windings of the generator and to so connect the winding to the mains as to give during the return or idle stroke a greater speed than that of the working stroke.

Railway Signalling Apparatus.

23929.—1909. H. W. Firth and F. W. Leake, Cheshunt. In this apparatus the contacts of a relay once they are brought together by a current, which may be momentary line current, are held in the closed position by means of a local current energising the relay magnet and operative so long as the relay contact circuit is maintained, in combination with locks on the plungers of block instruments giving permission to enter a given section, and a switch actuated by the movement of the block instrument plunger and adapted to effect de-energising of the relay and establishing connections whereby it may be re-energised by the train passing over a rail contact or treadle.

Automatically Controlling Electric Circuits for Lighting Vehicles.

25040.—1909. J. G. Royce and H. G. Sharp, Bermondsey, S.E. On the dynamo shaft is mounted a pair of spring grips which are adapted to grip a drum revolved from the driving element of the vehicle. The grip varies with the strength of the spring and depends on the spring. A pair of brushes spring held inwardly act as a centrifugal contact maker and breaker; the brushes move outwardly to connect with a surrounding ring when the armature revolutions exceed a certain number.

Condensers and Artificial Lines for Duplex Telegraphy.

25103.—1909. A. Muirhead and Muirhead & Company, Beckenham. The tin foil sheets are provided with lugs which extend beyond the dielectric so as to enable the joints to be tested. The sub-divisions of the sheets are connected in series by lengths of resistance wire arranged outside the dielectric.

Heating Water by Electricity.

25296.—1909. C. Kratt, Glasgow. The heater comprises a trough made of non-conducting material in which resisting material is arranged so as to present a large heating surface to the water. Means are provided for passing an electric current through the resisting material.

Electric Arc Lamps.

25373.—1909. L. C. H. Mensing, Edinburgh. The magazine, which hold the carbons have two angled smooth-surfaced tracks, each containing a ball which normally presses the carbons towards the magazine next to the feed or guide tube so that the carbons are properly positioned with relation to each other and the end carbon allowed easy movement for feed purposes. Each track has a bulge portion at the highest end so that the magazines can be completely filled. Rollers are provided at the feeding edge of the magazines for easier self-feeding of the carbons.

Inductive Wireless Telephone System.

25407.—1909. H. von Kramer, Erdington. This is a wireless inductive telephone for trains and other vehicles and comprises a stationary circuit which includes a pair of conductors laid parallel to the direction in which the vehicle travels. The out and return wires of the circuit are crossed at intervals so as to be non-inductive to outside influences. A movable circuit carried by the vehicle includes an inductive part of sufficient length. A number of wires are also provided to induce sufficient current in the fixed circuit or between two movable circuits on different trains through the fixed circuit. The movable circuit is free of inductive relation with outside influences.

Electric Irons.

27816.—1909. J. Smith, H. L. Mitchell, W. H. Askham and H. Hey, Dewsbury. A solid metallic portion is fitted above the usual sole of the iron and provided with sockets for the reception of resistances. The sole has lateral projecting flanges. A cover conforming to the countour of the solid portion is fitted over it, but insulated from the metal by asbestos. The cover is secured to the flanges of the sole.

Wireless Telephony.

25639.—1909. H. G. Matthews, Thornbury. The apparatus comprises a frame round the edge of which is a number of bundles of wires of magnetised steel. The lengths of the wires are placed at right angles to the plane of the frame. An insulated conducting wire is wound several times round the frame. The electric impulses are transmitted through the wire to initiate the wirelessly conveyable vibrations or alternatively those generated by wirelessly conveyed vibrations. A telephone transmitter and a high frequency interrupter are in circuit with the winding around the frame. The interrupter consists of a pair of contacting surfaces in rubbing contact such as to interpose an electrical resistance worn off by the rubbing and renewed on the passage of the electric impulse.

Exhaustion of Metallic Filament Lamps.

25889.—1909. H. Zuzel, Baden. The process consists in cooling the quicksilver in the exhaust pump plant and in absorbing any quicksilver vapours tending to enter the bulbs by metals having a large superficial area located in cooled vessels interposed between the exhaust pump plant and the bulb. The quantity of mercury entering the bulb and present after sealing is reduced to a minimum.

Electric Selective Devices.

25896.—1909. American Automatic Telephone Company and C. L. win, New York. This is an improved progressively movable device in which a selector switch is actuated by a succession of electrical impulses sent over a circuit controlled by two relays. The slow relay of the improved device controls a release circuit for returning the selector to normal position after use. The slow relay when de-energised directly closes the circuit of a release magnet.

Electric Pneumatic Organ.

25932.—1909. L. G. Metzger and E. C. Smith, Old Trafford. The electro-magnets are mounted outside and distinct from the round board and are arranged to act directly on the pallets, motors, valves and all other mechanism employed in the instrument. The system can be applied to existing organs without structural alterations, and repairs can be effected without dismantling the instrument.

Controllers for Electric Motors.

29200.—1909. Electric Construction Company, Ltd., and W. Close, Wolverhampton. The moving contact which is required to make rubbing contact with a main contact is supported from the turning arm of the controller through the medium of an elliptic spring, the length of which runs in the direction of the rubbing between the contacts.

Electric Time Switch.

30216.—1909. P. Schroder, Stuttgart. In this apparatus the solenoid after having closed the main switch and become clutched to the clockwork is subsequently released by the engagement of a pin on the locking pawl with a segmental disc in such a manner that the solenoid is released and falls to open the main switch.

Working Arc Lamps in Series with Incandescent Lamps.

747.—1910. A. Heimann, W. Schaffer, Berlin. The resistance in series with the arc lamps is constituted by incandescent lamps connected in series with variators. A battery of polarisation cells is connected in front of the arc lamps in parallel with the variators and incandescent lamp circuit.

Electric Lamp Holders.

1597.—1910. Siemens Brothers & Company, Ltd., and J. S. Huddleston, Beckenham. In order to prevent lamps of a definite candle-power from being used with holders constructed for lamps of a lower candle-power, insulating projections are fitted to the lampholder contacts to correspond with recesses in the lamp contacts. The depth of the recesses is fixed for each particular candle-power.

Railway Warning Device.

4541.—1910. Walters Electrical Manufacturing Company and C. E. Moore, London, W. An electro-magnet with iron cores and steel pole pieces is so arranged that the armature closes a local circuit when the electro-magnet is energised on one circuit and remains closed until the electro-magnet is energised in the reverse direction on another circuit. The device is used to give warning of the approach of a train.

Dynamo Electric Machines.

15753.—1910. Allgemeine Elektricitats Gesellschaft, Berlin. In order to protect the winding of electrical machines from chemical influences and to improve the heat dissipation, the interstices between the separate windings and the insulating tubes enclosing them are filled with an insulating material. During the introduction of the insulating material the winding is heated by means of electric current.

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THE
Electrical Engineer.
An Illustrated Record and Review of Electrical Progress.
WITH WHICH IS INCORPORATED "ELECTRIC LIGHT."

Old Series, Vol. LI.
New Series—No 26, Vol. XLVI. LONDON, DECEMBER 23, 1910. Price 3d.
Registered at the General Post Office.

NOTES.

Aberdeen's Progress.

The annual inspection of the Aberdeen Corporation Electricity Works by the Town Council afforded Mr. Bell, the electrical engineer, an opportunity of giving a few striking particulars showing the remarkable growth of this undertaking. Twelve years ago the works were valued at £60,000 only. Since that £300,000 has been spent on them, plus another £100,000 on tramways. Meanwhile the demand for electricity has grown by leaps and bounds, not only for lighting but for power purposes in all kinds of industries. Mr. Bell said that the machinery of nine firewood merchants in Aberdeen was driven electrically. Separators for separating cream in use in nine dairies of the city were driven by electricity, while coffee was roasted, if not ground, electrically in Aberdeen. Twenty bakers in Aberdeen had their plant electrically driven. The newspapers had electric plant. The letters at the Post Office went through an electric sorter, and were stamped electrically. The machinery of 35 of the shoemakers in the city was driven electrically, and those of the Council who were smokers would be interested to know that an electric pipe-making machine was in use in town. Electricity was employed to draw the salmon fishers' nets in the Bay. In butchers' shops in Aberdeen there were 55 electric mincing machines, and aerated water and bottling appliances in town were driven by 12 machines.

London Railway Electrification.

It is instructive to find the London, Tilbury and Southend Railway Company moving in the matter of electrification. The proposal is to apply to Parliament for powers to increase capital by about one million sterling, to be spent on power stations and sub-stations, electrification of the line and the purchase of new rolling stock. The company have already had actual experience of electricity, as their system is electrified as far as Barking, the District Railway Company running over this section from the City by arrangement. It is hoped to accelerate service and thus attract more traffic, which would be handled more economically than by steam traction. Meanwhile a pleasant illustration of one advantage of electrification is afforded by the District Railway, which is gradually becoming a bower of greenery and flowers. The directors, by means of prizes and by official planting, are filling up many odd corners along the line and making even London stations delightful with plants. Of course, this could never have been done in the old days of steam and of sulphur fumes.

Main Line Electrification.

While we are content to employ electricity on urban lines only, its use on main lines is being pushed forward in other countries, notably Germany and Switzerland. Canada, judging by latest advices, is preparing for a bold move in this direction. Russia is also earnest in this matter, and the question of fuel for generation of electricity in and around St. Petersburg, where water power is not available in sufficient quantity, is causing anxiety. Mr. N. L. Lazarieff has been lecturing before the railway section of the Russian Technical Society on turf as fuel. There is abundance of turf near St. Petersburg, and it is known that the gas-motor stations, with powerful gas-motors, yield from the turf at the same time a valuable market product—sulphate of ammonia—and a large quantity of gases, which latter may easily be turned to the production of energy. Turf is so deep near St. Petersburg that 1,620,000 poods of turf can be taken per dessiatine (2·7 acres) useful for fuel, and there is enough for 50 years, so that energy thereby can be had much cheaper than by water or steam. Further, said the lecturer, gas-motor stations are more cheaply erected than any other kind of power-station.

Turkey Possibilities.

Of late particulars of several important Turkish electrical contracts have been given in our columns. These referred to points so divergent as Constantinople and Jerusalem. The fact is, however, that much attention is being paid to electricity by the newly-awakened Turk. Importation of electrical machinery is constantly on the increase, being required for mining and irrigation projects, for mill driving, while small motors for tool driving are much in request. With the installation of public supplies of current this demand is bound to increase, and although Germany has established itself in this branch of export, the trade is well worth looking after by British manufacturers.

Smart Work.

A correspondent sends us particulars of a smart bit of work carried out by the regular staff of the Shipley Council Electricity Works. A local manufacturer wanted electrical power in a hurry; at 10 a.m. he telephoned to the works, an hour later the application form was filled in and signed by the applicant and the deposit paid over. Within 24 hours a motor outfit, including switchgear, etc., had been removed from another firm's premises (where a larger motor had been installed) and taken to its home and re-fixed, the distributor cable tapped and jointed on to a service cable, the necessary wiring erected, and all connected up and in working order. This speaks well for Mr. S. D. Schofield's staff, and ought to prove a valuable lesson as regards the reliability and flexibility of electricity for power purposes.

ASSOCIATION OF ELECTRICAL ENGINEERING STUDENTS.

L.C.C. School of Engineering and Navigation, Poplar, E.

The Conversazione and Social evening in connection with the above Association took place at the School on Saturday, December 3, a very interesting programme being arranged. Members and their friends were received by the President of the Association, H. A. Garratt, Esq. During the evening a concert was given and four interesting lecturettes were delivered by the following gentlemen on various topical subjects. "Colour and Electric Light," by J. Paley Yorke, Esq.; "Fireworks," by B. J. Field, Esq.; "Frozen Mutton and Other Edibles," by J. H. Robson, Esq.; "Iron from Mine to Foundry," by D. Gordon, Esq. Exhibitions and demonstrations were given in all laboratories and workshops. The next meeting of the association has been arranged for Saturday, December 17, at 3.30 p.m., when a paper on "Electric Waves" will be read by Mr. E. A. Martin. All past and present members of the School are invited to join the Association. Information can be obtained at the School, of the hon. secretary, W. T. Brading, 26, High-street, Deptford, S.E.

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PROFESSIONAL PORTRAITS.

I. Silvanus Phillips Thompson, B.A., D.Sc., LL.D., F.R.S., M.R.I.

By Paul F. Mottelay.

At the Royal Institution of Great Britain, on the coming December 29 and 31, and on January 3, 5, 7 and 10 will be given a Christmas course of experimentally illustrated lectures on Sound, Musical and Non-Musical. These are to be delivered by Professor Silvanus P. Thompson, Principal of the City and Guilds Technical College, Finsbury, whose extended scientific investigations and discoveries, as well as remarkable qualifications as a lecturer, are already world-wide.

Professor Thompson, of whom the accompanying original photograph was especially taken last month, for this publication, is a native of York, where he was born, of Quaker parentage, June 19, 1851. In 1881, he married Jane, eldest daughter of the late James Henderson, of Pollokshields, a lady of considerable musical and literary ability, who has in late years contributed many highly creditable articles to magazines mainly in the form of translations from the Italian and German. They have four daughters, who prove by their own literary, musical and other attainments, that they share to a great degree the versatility of their parents. The eldest, before her marriage, was a student of the Royal College of Music, and is an excellent violinist. The others have developed tastes for vocal or instrumental music. The second studied at Newnham College, and took the National Science Tripos; she and one of her sisters hold the degree of B.Sc. in the University of Cambridge.

The subject of our sketch was educated at the famous Friends (Bootham) School in York, which he left in order to attend the Flounders Institute, Pontefract, and afterwards followed a course at the Royal School of Mines, before visiting the Heidelberg University. His extraordinary proficiency in learning and his indefatigable researches won him many notable distinctions at the very outset of his career, and the progress which he has made since he entered that electrical engineering field in which he has so markedly distinguished himself, show a record to be envied by many but reached by only a few. At the London University, he was graduated B.A. in 1869, B.Sc. in 1875, and D.Sc. three years later, and he has since been made an LL.D. at Birmingham, as well as an honorary M.D. of Koenigsberg. He is a Fellow of the Royal Society, of the Royal Astronomical Society, and of other learned bodies, also member of the Royal Institution of Great Britain, of the Royal Academy of Sciences of Stockholm, and of the American Philosophical Society, and has been Senator as well as Examiner of London University, in the organization of which latter he took a very prominent part.

In 1876 he was appointed Professor of Experimental Physics in the Bristol University College, and so continued until 1895. Ten years before the latter date (1885) he had been elected Principal and Professor of Physics in the City and Guilds Technical College, Finsbury, both of which posts he still occupies at the present day. He has since been President of the Junior Engineering Society (1890); President of the Röntgen Society (1897); President of the Institution of Electrical Engineers (1899); President of the Physical Society (1901 and 1902); President of the Optical Society (1905); President of the South-Eastern Union of Scientific Societies (1907); President of Section G of the British Association (1907); President of the Illuminating Engineering Society (1909), and had been, besides, elected honorary Vice-President of the Electrical Exhibition at Frankfort (1891), as well as British delegate to the Electrical Congress of Chicago (1893). At the latter Congress he read a paper on "Ocean Telephony," in which he suggested the idea of accelerating the speed of signals through ocean cables by employing inductive shunts at intervals along the cable. Dr. Thompson has likewise been made President of the Club called "The Sette of Odde Volumes," the only club he has besides joined being the Athenæum.

The extraordinary command of languages possessed by Dr. Thompson enabled him to personally deliver two admirable foreign lectures—one, in Italian, before the Volta Centenary Congress at Como, which he attended as a delegate in 1899, on "Magnetic Images and their Application in the theory of the Rotatory Field Motor"; and the other, in German, on "Michael Faraday," before the Urania Society of Berlin, during January, 1901. In the month of June of the latter year he delivered, at Oxford, the Boyle lecture on "Magnetism in Growth." Amongst his numerous other important papers should be singled out those forming the subject of the Cantor Lectures of 1883, 1890 and 1895. The first, it has been truly said, established his reputation of being a leader in the special study of the construction, theory and mode of working electro-dynamic machinery. The second, in 1890, was on "The Electro-Magnet," a subject to the study of which he had given much of the previous seven years; whilst the third, in 1895, was entirely devoted to the arc light. Other lectures worth noting especially are those of 1887 and 1888, before the Institution of Electrical Engineers, respectively, on his "Telephonic Investigations and on the Influence Machine"; of 1898, on "Rotatory Converters"; of 1905, at Society of Arts, on "High-speed Electric Machinery, with special reference to Steam Turbines, Dynamos and Alternators"; and the first Kelvin lecture delivered at the Institution of Electrical Engineers during 1908. He contributed largely, besides, to many of the leading scientific publications, some of the most important being the papers "On Physical Optics and on Geometrical Optics," through the Physical Society, and that "On the Mercurial Air-Pump," through the Society of Arts.

PROFESSOR THOMPSON IN HIS LABORATORY.

He is the author of numerous valued works which have placed him foremost in the fields of both pure and applied science. He began in 1886 the publication of his treatise on "Dynamo-Electric Machinery," which is now in its eighth edition, and which has been translated into French and German; he published his book on "The Electro-Magnet" (a greatly enlarged reprint of the 1890 Cantor lectures), of which there were French, German and Russian editions; he re-wrote and considerably enlarged his "Elementary Lessons in Electricity and Magnetism," which had run into 40,000 copies in eight years and which appeared in French, German, Italian and Polish; in 1896 he issued the first edition of "Polyphase Electric Currents and Motors" (second edition 1899), which was translated into French and German, and during 1897 published a volume on "Light Visible and Invisible." He, besides, wrote "Michael Faraday—His Life and Work" (1893), the "Life of Philip Reis," who invented a telephone, 1860–1863 (1883), and he is at the present time reaping the benefits of the three years he devoted to the preparation of "The Life of Lord Kelvin," which has just been issued through London publishers in two large attractive octavo volumes.

Dr. Thompson was one of the founders of the Gilbert Club, organized for the express purpose of rendering into English the 1600 *De Magnete*. He took a very prominent

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part in the translation and published an admirable and very valuable series of notes thereon, following them up with numerous lectures on the life and work of the first electrician. To the above, he added a translation of the 1269 *Epistola* of Petrus Peregrinus, which he likewise had printed by the great Chiswick Press in right royal form for private distribution. In the preparation of the notes as well as of the lectures and numerous articles for the press that followed upon these early writers, Dr. Thompson was fortunately aided by the large library of electrical literature which he possesses. His collection of early editions, known to the writer of the present article, is without question the largest in existence, far surpassing the Ronalds and Latimer Clark libraries, not only in number and in separate issues, but in the excellence of the bindings. He is, besides, the possessor of other collections of finely bound works in different classes, as well as of medals, autographs and engravings.

The wide range of subjects shown above to have been covered by Dr. Thompson have won for him several awards from scientific bodies, as have also many of his discoveries. To him is due the singular optical illusion known by the name of "strobic circles," and, as was well stated at the time, he has the honour of having applied Clerk Maxwell's electro-magnetic theory of light by way of explaining the behaviour of tourmaline crystals in their action upon polarized light and of having even constructed electro-optic models of the crystals from iron, wire and glass. He also discovered that the heavy metals, such as uranium and osmium, are better emitters of Röntgen rays than those of lighter atomic weight.

We must record the fact of the singular versatility of Dr. Thompson, as further evidenced by his admirable water-colours of Alpine mountain glaciers and of Canadian scenery, as well as his sketches in black and white, his card illuminations, his etchings of portraits, like that which he made for his work on Michael Faraday, and his rubrications of the 1269 Petrus Peregrinus translation.

The accompanying photograph shows Prof. Thompson at work in his private research laboratory at the Leonard Street City and Guilds Technical College. As he stands before us, we find him to be a man of average height and of good build, well groomed, whose ruddy colour of face and fair skin indicate the enjoyment of good health. His head, well poised upon strong shoulders, is tinged with grey and somewhat inclined to baldness. The brow is wide and the eyes are clear and well set, denoting quick, intelligent perception. In manner he is quite alert, very genial, frank and open, yet at times impressing one with a sense of extreme delicacy that might be construed into diffidence. His voice is quite sympathetic, and, although not of high pitch, is very clear, while his enunciation is remarkably good. Altogether, we have thus presented to us a man of very agreeable personality. To this and to the peculiarly comprehensive manner in which his teachings are presented, may be attributed the wide popularity he enjoys among the students, much in the same manner as he is esteemed by all those who have listened to any of the numerous addresses and other contributions to which we have already made allusion. A great deal has been said, and deservedly, in praise of the careful, methodical preparation of his lectures, evidencing, as they do, laborious bibliographical and statistical research, well supported by data procurable only on experimental grounds. He is very patient, painstaking, anxious to develop the bent of his many students, and it has been truly said that, as a teacher and trainer of young men, more especially in electrical engineering, he is believed to have no superior throughout Great Britain.

PERSONAL.

Mr. Ben Hesketh, B.Sc., chief assistant engineer to the Folkestone Electricity Supply Company, Ltd., on leaving to take up an appointment in the Argentine, received a handsome presentation.

The electrical staff of the Bengal-Nagpur Railway, which has Mr. E. S. Franklin at its head as chief engineer, has been strengthened by the appointment of Mr. Douglas Kerridge as second assistant.

CONTROL OF ELECTRIC WINDING AND HOISTING ENGINES.*

By Dr. E. Rosenberg, Member.

SUMMARY.

The paper firstly discusses in brief the general features of the different systems of winding engines, viz., direct current winding motors with controlling generator (Ward-Leonard, Ilgner), direct current winding motors with rheostatic control, and alternating current winding motors with rheostatic control. The control apparatus is then described and illustrated.

The dependence of the motor speed in each of the systems on the load and on the controller resistance is discussed.

A considerable part of the paper is devoted to investigations on the use of the motors as electrical brakes, and the conditions of regenerative control, braking with counter current, and braking by supplying current to independent resistance are considered. The effect of speed variation and excitation upon the torque is investigated with direct current motors, and with alternating current motors excited by direct current, and test results are given.

Lastly, the application of the eddy current brake is mentioned, test results of different sizes of eddy current brake are analysed, and the difference between such apparatus with copper and iron armatures is explained.

Four years ago, in this Institution, three most interesting papers by C. B. Sparks,† W. C. Mountain,‡ and G. Hooghwinkel§ were read, dealing with electricity in mines in general, and with the question of electric winding engines in particular, and these papers, as well as the heated discussion following them, brought out all the arguments in favour of and against electric main winding engines. By all parties it was agreed that hoisting engines may with advantage be driven by electricity, but in respect to main winding engines the views as to the economic possibility of an electric drive were seriously divided.

Times have passed, and electric winding has developed at home and abroad, and at present there are in Great Britain and the British Colonies alone such a great number of winding engines in actual service, or in process of erection, that one can safely say that for certain conditions, at any rate, electric winding has not only proved economically possible, but a distinct economic success. Especially in cases where power can be bought cheaply from a public power station, or where the private power station can be used to supply either several winding engines, or at the same time a great variety of motors with fairly good load factor, the advantages of cheap power production by the adoption of large and economical working units has more than balanced the necessity of double conversion of energy. In many cases the electric winder is not only the cheapest in working, but also the cheapest in first cost, and when this most important foundation of economic advantage is established, the user also appreciates the additional amenities provided by the excellent technical features of electrical drive, namely, the ease and safety of control, the entire absence of jerks, and the perfect regularity of drive from full to creeping speed.

So far, the direct current motor and the polyphase induction motor have generally been used for electric winding engines of large capacity, and only these will be considered in the present paper. Single-phase commutator motors could be used, but are expensive, and not so efficient as the other motors. Single-phase induction motors present difficulties of control, and, therefore, will rarely be used for direct driving of large winding engines.

As far as the control of direct current and polyphase induction motors is concerned, we have mainly to distinguish between rheostatic control used for either type of motor, and Ward-Leonard control used only for direct current motors, for which a special controlling generator is employed. The rheostatic control, that is, the starting from a substantially constant bus-bar voltage by the insertion of a gradually decreasing resistance, inserted either in the armature circuit of a direct current motor, or in the rotor circuit of an induction motor, can be done either with

* Abstract of paper read before the Institution of Electrical Engineers.
† "Journal of the Institution of Electrical Engineers," vol. 36, p. 477, 1906.
‡ Ibid., p. 499.
§ Ibid., p. 506.

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metallic or liquid resistances. For large motors, and nearly always for induction motors, liquid controllers are employed. Fig. 1 shows the general principle of an induction motor controller for large output. *a* is the controlling lever used by the driver, acting at the same time on the reversing switch D for the stator, and on a sluice-gate P limiting the height of the liquid in a tank E, which is fitted with three stationary electrodes connected to the rotor slip-rings. The liquid is kept in constant circulation by means of a motor-driven circulating pump N, and is cooled in the lower part of the tank by means of cooling coils T. The circulating speed of the liquid can be regulated by means of the valve S. The main motor is, as a rule, wound for high voltage; there is a step-down transformer L inserted for the pump motor M.

With such an arrangement the driver is not able to cut out the rotor resistances too fast. He can fix the position of the sluice-gate when starting, but the water-level is only gradually raised to this position, according to the pump speed and the opening of the regulating valve. The solution is used over and over again, and only requires occasional replacing of the evaporated water. The cooling water (just as in a surface condenser) is not allowed to mix with the solution. A photograph of a liquid controller for a 1,400 h.p. 3-phase motor is given in Fig. 2. Fig. 3 shows the induction motor controlled by this apparatus coupled to a winding drum.

Although the slow-speed motor thus required is more expensive than a high-speed motor, and also has a lower power factor, the direct coupling is, for large outputs, very often adopted, as these disadvantages count for little compared with the advantage of increased efficiency and elimination of the mechanical transmission gear, provided the drum speed is not too low to permit of a reasonable motor design.

Ward-Leonard control requires a special direct current generator either engine driven, or more often, driven by an electric motor supplied with current of constant voltage (either alternate current or direct current) from general bus-bars (Fig. 3A). The generator part is a direct current generator with separate excitation, which can be changed between the limits of zero and a positive and negative maximum. The winding motor (Fig. 3B) is externally constant excited, and its armature connected to the generator armature without any switches or controller. The speed of the winding motor is, therefore, in approximate proportion to the voltage of the controlling generator, and the direction of rotation is directly dependent upon the direction of the exciting current of the generator. A small shunt controller gives perfect control over the whole machine.

Figs. 4 and 5 show this controller drawn to approximately the same scale as Fig. 2. If the arm with the contact brushes visible in Fig. 5 is in the vertical position (corresponding to the " off " position of the driver's lever, see Fig. 4), then the generator is not excited, and a connection is made in the generator windings which counteracts the residual magnetism. By a gradual movement of the contact arm in clockwise direction, the generator will be excited, and the generated voltage will produce a certain direction of rotation of the winding motor. For a movement of the contact lever in counterclockwise direction from its neutral position, the generator voltage, and with it the rotation of the winding motor will be reversed. The photographs show at the top of the shunt regulator another small controller with a handle which is mechanically interlocked with the main lever. This small controller represents merely a switch used in case of winding intervals of long duration for switching off the excitation of the winding motor; a discharge resistance is fitted to this switch.

The Ward-Leonard system gives wonderful ease of control, and very light and simple controlling apparatus; the amount of machinery, however, is increased, as are the initial costs, and the great advantage of practically negligible starting losses is partly counterbalanced by the loss of efficiency in the motor generator. As far as current consumption is concerned, the Ward-Leonard system will show to great advantage if starting and braking periods are of comparatively long duration, and winding intervals short, also if trips with reduced speed (for instance, for men winding), are of frequent occurrence; whereas the straight rheostatic control will show up best if full speed runs and winding intervals represent a very great portion of the whole working time.

Very often it is considered essential to guard against interruptions of the supply, and to provide means which would enable the continuation of at least one trip. The Ward-Leonard system lends itself very nicely to a storage of energy by coupling with the motor generator a flywheel (Ilgner system). This also allows of equalising the demand on the power station by providing the motor of the Ilgner set with a considerable drop in speed between no load and overload, and thus giving the flywheel an opportunity to discharge a part of the stored energy when the load grows, and to store energy between the periods of work. Instead of the flywheel, a third machine, viz., a direct current generator, can be used, which works in parallel with a storage battery.

In case of direct current winding motors working direct from the bus-bars, it is possible to use for such purposes a direct current motor coupled to a flywheel, and fitted with special field windings, or an automatic shunt rheostat, which, according to the momentary requirements, will cause this machine to work either as a motor or as a generator, and so either to store energy in the flywheel or to convert the stored energy into electrical energy. An accumulator battery, either with or without automatic booster will serve the same purpose.

In case of alternating current winding motors similar ends have been achieved by running from the mains a synchronous motor coupled to a flywheel, which motor, in case of failure of the line current, will act as a generator and feed the winding motor; or by running a rotary convertor the direct current part of which is connected to a direct current flywheel motor. In this latter case the equalising action of the flywheel during the ordinary service is also made use of.

The aim of the present paper is mainly to study the electrical conditions of control, and more particularly the conditions for braking in the different systems. We have always to reduce the speed at the end of a trip and to bring the winding engine to a standstill, but very often we have also to lower unbalanced loads instead of lifting them, and in this case the winding motor, if it is to be used at all, has to work as a generator converting mechanical energy into electrical. In many cases the change from positive to negative motor torque will occur during each trip.

If no tail rope is used, and the load on the up-going cage is just balanced by the load on the down-going cage, then the rope weight will, in the first half-trip, exercise a positive, and in the second half a negative torque, and the winding machine has at first to act as a motor and then as a brake.

Ward-Leonard System.

As long as the speed of the Ward-Leonard motor generator is kept constant, the shunt regulator of the controlling direct current generator determines fully the E.M.F. of the controlling machine, and if the winding motor is mechanically driven from outside, the speed of the constantly excited winding motor will attain a value which gives an E.M.F. in the winding motor only slightly higher than that of the controlling machine, because already a slight difference will give rise to a circulating current of sufficient magnitude to balance the torque impressed from outside.

We have to make certain assumptions to determine how much the speed of the winding engine will differ for a given position of the controlling lever, whether the machine is working as a motor lifting a certain load or as a generator driven by the lowered load.

We shall assume at first that the exciting voltage is kept constant, and that there is no flywheel and no artificial slip in the motor generator, also that the primary frequency and voltage remain constant. The slip of the induction motor driving the controlling dynamo will be proportional to the load, and at full load will be at least 2%. The controlling machine, which as a rule is fitted with commutating poles, might for constant speed have a drop in voltage from no load to full load of 5% of the maximum voltage, and the winding motor will have a similar drop in speed, say again 5%, for constant voltage on the terminals from no load to full load. That would mean that the difference of the motor speed between no load torque and full load torque due to all causes combined will be approximately 12% if the induction motor has only 2% slip. If

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the winding motor has to exercise a negative torque of half the value of the normal working torque, the difference in speed will grow to 18%.

This difference of 18% of the full speed, however, remains nearly constant in its absolute value, and therefore grows in proportion, if the controller lever is put into a position for a low speed. For half excitation the lifting speed for normal load will be about 9% of the full (no load) speed and the lowering speed for a load which would require half braking torque will be about 56% of the full speed.

If an Ilgner set with increased slip is used, or if the exciter is coupled to the shaft of the motor-generator and its voltage is not automatically kept constant, the differences will be even greater. It is, therefore, necessary also in case of Ward-Leonard control to use a speed indicator, and not to depend upon a positive relation between the position of the control lever and the speed of the winding engine. In general, it can be said that the method of braking with the Ward-Leonard arrangement is nearly perfect in so far as the movements of the controller lever in order to come to rest are pretty nearly the same whether the motor is driving or driven, and that a very great braking torque can be obtained from the motor. Normal current in the motor armature when used as a brake represents more than normal torque on the winding drum. If the controller is not too quickly handled, there will be no unusual stresses either in the electrical or in the mechanical parts, which, of course, in any case have to be built to cope with the always occurring reversal of power.

The calculation of the speed variations possible for certain positions of the controller were made under the assumption that current can be returned to the line. If, however, the line voltage fails, be it that a circuit breaker comes out or by a similar occurrence, then the state of affairs alters considerably. If a flywheel of sufficient capacity is connected to the motor generator, the energy supplied by the lowering load will speed up the flywheel to a permissible value. If, however, no flywheel is applied, then the motor generator would soon speed up to a dangerous limit, and therefore it would be necessary in such a case to apply the mechanical brakes practically at the instant that the circuit breaker comes out.

In a system which instead of the flywheel uses a third electric machine connected to an accumulator battery, the storage of energy could, of course, go on, as a battery even if fully charged is always capable of receiving energy by being overcharged.

Rheostatic Control of Direct Current Motors.

We will now investigate the case of using the motor as a brake if rheostatic control is employed, the motor being supplied with current from general bus-bars. The first case would be that of a direct current shunt motor fed from direct current bus-bars. This case mainly applies to comparatively small motors, up to a few hundred horse-powers. The direct current motor can be built for combined series and shunt regulations, viz., variable resistances inserted in the armature circuit and a shunt regulator in the exciting circuit. This reduces the rheostatic losses in starting as the speed regulation effected by the shunt regulator is done without loss. For all speeds within the range of shunt regulation braking is done most effectively without any additional apparatus, because the motor, if its armature is connected to the bus-bars without intermediate resistances, will work as a generator if driven from outside and return power to the line.

For a given position of the shunt regulator (with the series resistances cut out) the motor when working as a generator and exercising half full load brake torque will develop (under above assumptions) a speed approximately 7% highter han the speed which it would develop for the same controller position if it was exercising full torque as a motor. It is assumed that the bus-bar voltage remains constant.

For other positions of the controller, when resistance is inserted in the armature circuit, the conditions are entirely different. First of all, the speed of the motor, even when working as a motor, will greatly vary according to the load, and a certain controller resistance which for full load reduces the motor speed by 20%, will for 100% overload produce approximately 40% drop, and for no load no appreciable drop. In other words, with resistance inserted in the armature circuit, the E.M.F. impressed upon the motor armature is no longer approximately constant but will vary with the load. Working as a motor, the E.M.F. of the machine will be considerably smaller than the bus-bar voltage, and working as a generator the machine will have to develop considerably greater E.M.F. in order to return power through the resistance to the line. Using again our example of 100% motor torque and 50% brake torque, a value of the series resistance which gives a full load motor speed of 90% of the no load speed would allow approximately 105% generator speed; 80% motor speed would correspond to 110% generator speed; 50% motor speed to 125% generator speed; and a position for creeping speed of the motor, say 5%, would allow a generator speed of approximately 148 %. A position of the controller which allows for the motor before starting, less than normal current, would allow a very dangerous speed for the same machine when generating. The above figures represent steady values, assuming that (as in deep shafts) the controller position can be maintained long enough to obtain these values.

These figures make it clear that such controller positions are in general not suitable for lowering loads, and that this regenerative control will mainly be used with the controller in "full on" position. It will often be the case that to start the lowering trip motoring current has to be sent at first into the motor. But it is essential that the controller lever should soon be pushed to the "full on" position, and kept there in order that the speed may not grow beyond control.

The regenerative control cannot be used to slow down the motor at the end of the trip. For this, either the controller has to be moved quickly into the "off" position and the mechanical brake applied, or the controller may be quickly moved beyond the "off" position and the first steps for the reversed movement used, which allow outside current to enter into the motor in such a direction as would be needed for lifting the load which is being lowered.

In the case of regenerative control the winding machine has to generate an E.M.F. in excess of the bus-bar voltage, and the braking current is defined as the difference of generated E.M.F. and bus-bar voltage divided by the controller resistance (including armature resistance). For reversed controller position (braking with counter current) the E.M.F. of the winding machine acts in the same direction as the bus-bar voltage and the braking current is defined as the sum of both voltages divided by the controller resistance.

Let E be the bus-bar voltage, and n the no load speed of the motor, and let I_i be full load motor current, and R the resistance of the controller (including also the resistance of the armature circuit), and let E be the E.M.F. of the motor corresponding to this resistance R when the motor is exercising full load torque, and developing a speed n_i. Also let E_2 be the E.M.F. of the winding machine acting as a generator for the same resistance R and producing a braking current I_2 at a speed n_2, then we have the following formulæ:—

The braking current—

$$I_2 = \frac{E + E_2}{R}$$

$$E_2 = I_2 R - E.$$

$$n_i = \frac{E_i}{E} \quad n = \frac{E - I_i R}{E} n.$$

$$n_2 = \frac{E_2}{E} n = I_2 \frac{R - E}{E} n.$$

During the moment of slowing down the value of the braking current I_2 is not self-defined; it is clear that according to the time we allow for slowing down, the momentary value of the braking current will be higher or lower, and that, generally speaking, any value of the resistance R (below a certain limit) can be used for stopping, and that the stopping period will be the shorter the smaller the applied resistance R is.

It will also be seen that the limiting value (R critical) of the resistance for slowing down is defined by—

$$R_{crit.} = \frac{E}{I_{stat.}},$$

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if $I_{stat.}$ represents the current in the motor armature which would keep static equilibrium to the load torque (including friction).

If from a certain lowering position we were suddenly to throw the controller to the lifting position with the critical value of the resistance the load would maintain its speed whatever the momentary speed might be. Higher values of the resistance give acceleration, lower values retardation. If the load is brought to rest by first applying a smaller resistance, then the critical resistance position can be used to keep the load floating.

In case the speed throughout the whole lowering trip has to be kept lower than the speed which the motor develops with all the armature resistance cut out, for instance, for lowering of men, counter current must be used during the whole trip.

In general, we want for braking purposes a current which is lower than the normal motor current for lifting, for the efficiency of the mechanical gear will, of course, necessitate an increase of the motor torque above the load torque, and reduce the generator torque under the load torque; whereas, therefore, for lifting the resistance will have to be smaller than $\frac{E}{I_{stat.}}$, it will be necessary for continuous braking with counter current to have a resistance larger than $\frac{E,}{I_{stat}}$ and for $I_2 = \frac{I_1}{2}$ the resistance will have to be bigger than $\frac{2\,E.}{I_1}$ Therefore, a metallic controller which is to be used for braking with counter current will have to be made of more than double the resistance of an ordinary controller, and a separate portion of the controller must be used for braking.

Regular braking with counter-current is a very safe, but naturally wasteful method, as not only is no energy returned to the line, but a current from the line is consumed equal to the brake current. The energy wasted in the controller represents the sum of the energies drawn from the line and generated by the load. Whether this waste of energy is objectionable or not depends upon the frequency and duration of down trips with unbalanced load. If such trips, for instance, occur regularly only once a week for an hour or two, then the waste of current during 1 or 2 per cent. of the whole working time will not be of much consequence as regards the total working cost of the whole apparatus. In other cases with frequent unbalanced down trips the waste of current might represent a serious item.

Rheostatic Control of Induction Motors.

With a polyphase induction motor used as a winding motor, the conditions are exactly analagous to those of a direct-current shunt motor (without shunt regulator) fed from busbars. If the rotor is short-circuited, the machine will, for a slight increase in speed, act as an induction generator and return power to the line. With the slip-rings directly short-circuited, the difference between no load and full load speed of the motor would be approximately 2 per cent., and the speed of the motor working as a generator on half load would be only approximately 3 per cent. above the full load motor speed. Liquid controllers, however, are seldom completely short-circuited, and, therefore, the speed difference might be nearer to 6 or 8 per cent.—just about the same as previously mentioned for shunt motors.

In order to break the motor down to lower speeds, counter-current is required, and exactly the same relation for the controller resistance holds good as that already developed for the shunt motor. Driving the motor at over-synchronous speeds with resistance inserted (controller in lowering position) would here also cause too high a speed to be reached.

So far, we have considered braking methods which do not require any additional apparatus, or any connections different from those which are made in the normal process of controlling the motors as motors. We shall now consider the possibility of braking methods with different connections, and also with additional apparatus.

Direct-Current Motor as Dynamic Brake.

We can disconnect the armature of a direct-current motor from the line, and connect it either to a part of the resistance of the starting controller, or to another resistance. If the machine is constantly excited from the busbars, the braking torque or braking current will be in direct proportion to the speed of the motor, and in inverse proportion to the controller resistance; therefore, in order to keep perfect electrical control of a constant lowering load from the start up to the very end of the trip, it would be necessary at first to increase, then to reduce the outside resistance gradually in proportion to the desired momentary speed. Of course, a constant resistance could be used which would only limit the steady speed of the lowering load, and some other means could be used to bring the load to rest at the end of the trip. For instance, a resistance which in series with the armature would allow full load starting current to be taken from the line, will, when connected across the armature, allow a braking current equal to half full-load current for approximately half-speed of the machine driven by the load. To allow full lowering speed for a brake torque equal to half full load torque, a controller resistance of the double value would be required, provided that no regulation in the shunt field of the motor is intended.

Here we have the same peculiarity as with all other braking methods where a resistance in the armature is applied, that an increase of this resistance increases the speed of lowering, whereas, for the motor working as a motor, an increase of resistance reduces the speed. An important fact in connection with this braking method is, that for a given speed the braking torque is nearly in inverse proportion to the controller resistance. For zero resistance the braking torque would be enormous for every appreciable speed, and the machine will, therefore, soon come to rest, or only develop a creeping speed.

Induction Motors with Direct-Current Excitation as Dynamic Brakes.*

This is entirely different in an induction motor, a part of which is excited by direct current (either the rotor or stator) and the other part connected to a resistance. As a rule, the stator which is normally wound for high-voltage alternating current will be connected to a low-voltage direct current supply and the three slip-rings of the rotor connected to a resistance of the corresponding number of phases. Such a machine represents an alternating current generator with stationary field, the exciting winding of which is distributed in the slots, and with a rotating polyphase armature connected to ohmic resistances. The frequency of the generator will, of course, vary according to the speed, and would be equal to the supply frequency if the rotor were rotating at full motor speed. The machine is distinguished from ordinary alternating current generators mainly by the fact that the air-gap is exceedingly small, and that, therefore, the armature reaction is exceedingly high. If the stator is excited with the equivalent value of the full load stator current and the rotor rotating at normal speed and giving a voltage equal to the open circuit rotor voltage and a current equal to full-load rotor current, then it will be found that the ampere turns on the stator are only a few per cent. in excess of the rotor ampere turns, whereas, in an ordinary alternating current generator the field ampere turns are generally twice as much as the full load armature ampere turns.

This big armature reaction has a very important bearing on the behaviour of the machine, because it is only for comparatively small armature reaction that it can be said that at constant speed the torque will be in nearly inverse proportion to the outside resistance. As soon as the armature current exceeds a certain limit a reduction of the outside resistance will not only increase, but even reduce the braking torque, because a slight increase in armature current is accompanied by a more than proportionate reduction in field strength. With short-circuited slip-rings the torque obtainable at higher speeds is very small.

If direct current is applied to produce a magnetising effect in a three-phase winding there are two arrangements which can be used without disarranging the windings :—

* Mr. R. E. Hellmund, Pittsburg, has recently published an interesting article on this subject in "Elektrotechnik und Maschinenbau," Vienna, 1910, p. 837, which is partly followed and partly enlarged in the following investigations. The latter ones, for the greatest part, had been finished before perusal of Mr. Hellmund's article.

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1. To connect one terminal to the negative supply, and the remaining two terminals in parallel to the positive supply.

   To connect one terminal to the negative supply, the second to the positive supply, and leave the third terminal free.

A different direct current voltage and current is required in cases 1 and 2, in order to produce the same effect that a certain three-phase current would produce.

We know that the rotating field in a three-phase motor can be considered to be of constant value at every moment. If we, therefore, preserve the instantaneous distribution of the current in the three phases by replacing the instantaneous value of the alternating current in every phase, by direct current of the same value, we shall have a stationary field of the same value as the previous rotating field.

In a star-wound machine, with terminal No. 1 connected to the negative direct-current supply, terminals Nos. 2 and 3 in parallel connected to the positive supply, the current in phase 1 will have the double value and opposite direction of the current in phases 2 and 3. Whereas, the current in phases 2 and 3 flows from the terminals to the star-point (negative direction) it will flow in phase 1 from the star-point to the terminals (positive direction).

This is a picture of just what happens when, in a three-phase system, the current in phase 1 is at the crest of the wave. Let us call the measured (root mean square) value of the alternating current in each phase C, then the momentary value of the current in phase 1 is 1·414 C, and of the current in phases 2 and 3, 0·707 C. It is, therefore, quite clear that in this connection the direct current replacing the three-phase excitation will have to be of the value 1·414 C.

Let us assume a star-wound machine, and connect only two of the terminals to the direct current supply. Then the current in the third phase is zero, the current in phases 1 and 2 of the same value but opposite direction. This corresponds to the moment in which, in the three-phase machine, the current in phase No. 3 goes through zero, whereas the current in the two other phases has exactly the values of

$$+\sqrt{\frac{3}{2}}\,C \text{ and } -\sqrt{\frac{3}{2}}\,C = +1.23\ C \text{ and } -1.23\ C.$$

In this connection, therefore, the equivalent direct current will be 23 per cent. higher than the measured value of the alternating current.

The watt losses in the first case are, if R represents the resistance of one phase :—

$$(1{\cdot}414\ C)^2\ R + 2\ .\ (0{\cdot}707\ C)^2\ R = 3\ C^2R,$$

and the same in the second case, viz. :—

$$2\ (1{\cdot}23\ C)^2\ R = 3\ C^2R.$$

Therefore, the direct-current voltage in cases 1 and 2 applied is in inverse proportion to the current.

Exactly the same holds good for delta connection. There also the direct current, if connected only to two terminals, has to be 23 per cent. in access of the measured alternating current value, whereas, if one terminal is connected to the positive, and the two others to the negative supply, the value of the current is 1·414 C.

We could excite the stator with a current as above, corresponding to the full-load stator current, and could insert in the rotor a resistance which would just allow normal rotor current to flow. In this case the magnetic conditions would be exactly the same as in an induction motor working with full load current at any moment of the starting period, and it is therefore clear that we should have normal torque at the circumference of the rotor. There is only the slight difference as to the torque on the rotor shaft, that for the motor we have to deduct the losses, whereas in the generator we have to add them. The normal full load brake torque on the shaft can therefore be obtained under these conditions with a current of a few per cent. lower than the above-named value of 1·41 C and 1·23 C respectively.

This is not necessarily the greatest torque we can obtain for this excitation, as a very simple investigation will show us, based on the well-known Rothert diagram for alternators. Assuming the resistance to be free from self-induction, we may apply the simple diagram of Fig. 6, in which O A represents the total ampere turns of the stator, A B the demagnetising ampere turns of the rotor, and O B the resultant ampere turns which are responsible for producing the real field (effective field + ineffective leakage field). In Fig. 6 it is assumed that the resistance inserted in the rotor is comparatively large, and therefore A B comparatively small and O B great. In Figs. 7 and 8 the outside resistance is gradually decreased, and therefore also the resultant field $O_1 B_1$ and $O_2 B_2$. The points B as *points* of a right-angled triangle are all to be found in circles over O A as diameter.

If the saturation is low, we can say that the resultant field will be in proportion to the resultant ampere turns O B. And as the torque is proportional both to armature current A B and resultant field O B, it can be represented by the area of the right-angled triangle O A B. Therefore, clearly, the maximum torque would be obtained for a value $A_1 B_1 = O_1 B_1 = 0{\cdot}707\ O_1 A_1$ (see Fig. 7).

Suppose we had a motor which, normally at full load is working at a power factor 0·8, *i.e.*, with approximately 80 per cent. current in the rotor, and 60 per cent. wattless current (no-load magnetising current and additional magnetising current for leakage). If we imitate these

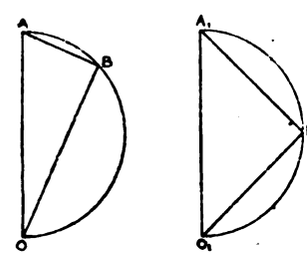

FIG. 6.

FIG. 7.

FIG. 8.

conditions in the motor used as break, the torque will not be as high as if we reduce the rotor current from 80 per cent. to approximately 71 per cent. These latter conditions will give a torque about 4 per cent higher than in the first case.

For a motor with 0·9 power factor, the maximum obtainable torque as a break could be increased by nearly 25 per cent. if the field had such a low saturation that it was capable of 60 per cent. increase in value with corresponding increase in field ampere turns.

In weakly saturated machines the E.M.F. in the armature will be proportional to O B and proportional to the speed of the armature—or, in other words, to the frequency of the rotor current. As the total resistance of the armature current (outside resistance plus internal resistance of armature and contact resistance of slip-rings) is repre-

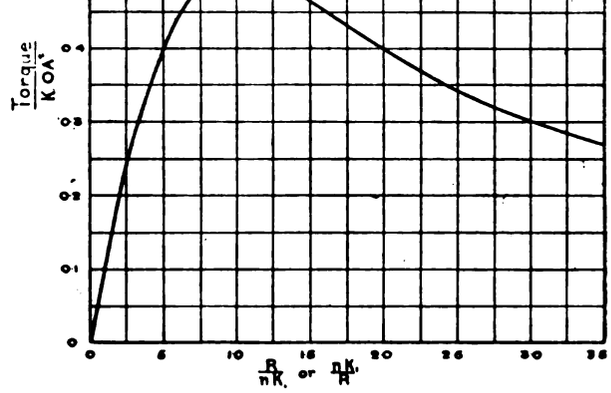

FIG. 9.

sented by the quotient of voltage and current, we find that the tangent of the angle O A B, multiplied by the speed, represents the resistance.

Our diagram is correct for all frequencies, as a given value of the stator and rotor current determine the resultant ampere turns, and therefore the resultant field. We can, therefore, get the same maximum torque at any speed so long as we change the resistance in the rotor circuit in strict proportion to the speed.

The general character of the speed-torque-curve *pr* of the resistance-torque-curve for a given excitation is easily

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determined. Assuming a weakly saturated machine we have, with reference to Fig. 6—

$$\text{Torque} \;\ldots\; T = K \,.\, O\,B \,.\, A\,B = O\,K \,.\, A^2 \sin \,.\, A \,.\, \cos \,.\, A,$$

K being a constant.

$$\text{Resistance } R = K_1 \,.\, n \,.\, \frac{O\,B}{A\,B} = K_1\, n \,.\, tg \,.\, A,$$

K_1 being another constant.

$$\sin\, A = \frac{R}{\sqrt{R^2 + n^2 \,.\, K_1^2}}$$

$$\cos \,.\, A = \frac{n\,K_1}{\sqrt{R^2 + n^2\, K_1^2}}$$

$$T = K \,.\, O\,A^2 \,.\, \frac{R\, n\, K_1}{R^2 + n^2 \,.\, K_1^2}.$$

This again can be represented either as—

$$T = K \,.\, O\,A^2 \,.\, \frac{\frac{R}{n\,K_1}}{\left(\frac{R}{n\,K_1}\right)^2 + 1}$$

or—

$$T = K \,.\, O\,A^2 \,.\, \frac{\frac{n\,K_1}{R}}{1 + \left(\frac{n\,K_1}{R}\right)^2}.$$

Fig. 9 shows, therefore, at the same time how the torque varies for a variable resistance if the speed is kept constant, or for a variable speed if the resistance is kept constant.

The Figs. 10, 11 and 12 show test results on a 30 h p. 500 volt 25 period slip-ring motor for different excitations, and they show near enough the same general appearance as the theoretical curve of Fig. 9. In every figure three curves are drawn representing torque and three curves representing rotor current. The full drawn line corresponds to direct current excitation in the stator of 50 amperes (one terminal connected to positive, the two others in parallel to negative). The dotted and chain dotted curves correspond to excitations of 36 and 25 amperes respectively.

The motor would give with a three-phase current of 500 volts, 36 amperes, a torque of 225 ft.-lbs. at 705 revs. per minute with a rotor resistance as shown in Fig. 10, and the rotor current would be equal to 52 amperes. The resistance per phase in Fig. 10 is approximately 0·3 ohw; in Fig. 11 approximately 0·6 ohm.

As long as we work with small direct current excitation, which could not saturate the field, the torque for a given speed and resistance will be in proportion to the square of the direct current exciting current, because the field O B as well as the armature current B A (Fig. 6) are in proportion to the primary current O A. When, however, O A is far above the value which could give a saturated field, then we have only to consider the variation of armature current A B for the maximum torque, because the field no longer increases with increasing ampere turns. The fact that for constant resistance the speed at which the maximum torque is obtained (Figs. 10 to 12) is slightly increased with increased excitation, is also caused by the limits of saturation. With high exciting current the resultant field does not grow in proportion to the resulting ampere turns, and therefore the maximum torque is reached with a comparatively higher rotor current. The curve representing the maximum torque dependent on the direct-current excitation is at first nearly a parabola which gradually approaches a straight line.

We see that the relation between torque and direct current excitation is a simple one, as the torque always increases with increased excitation, whatever the momentary frequency may be, whereas the relation between torque and resistance is a very complex one. For a decrease of resistance the torque might be increased or decreased, dependent upon the momentary speed. Therefore, it would not be very safe to use the variable resistance of the starting controller for braking purposes, as the driver might easily overshoot the mark in trying to make the brake more effective, and then he would not be able to stop the load. It would, however, be possible to change the resistance automatically in proportion to the frequency of the rotor currents.*

For a constant excitation and a constant resistance in the armature there always exists, as the figures show, a critical speed up to which the torque increases and after which the torque goes down with increased speed. If we make the exciting current and the resistance high enough, we can easily ensure that the brake torque wanted is well below the obtainable maximum torque, and that the speed

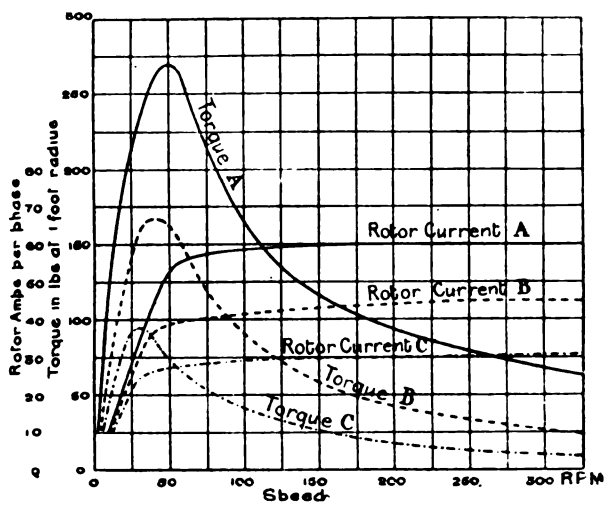

Fig. 10.

wanted is well below the critical speed; say, for instance, like M in Fig. 14. In this case the machine when started and driven by the load, the rotor connected to the resistance will attain a speed which is represented by the abscissa of the point M in Fig. 14. The load can be lowered with safety with the certainty that the speed will not be exceeded. For stopping mechanical brakes would be applied.

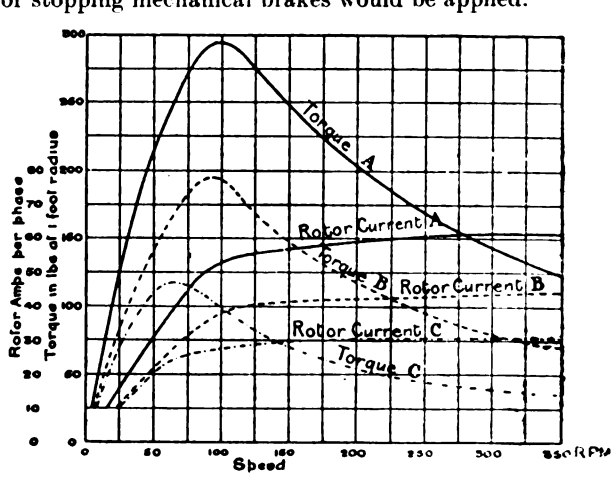

Fig. 11.

If the motor is allowed to come to rest with full direct current excitation on the stator, then, of course, no demagnetising effect of the armature can exist, and the enormous number of ampere turns will create the strongest possible field in the motor. This must be carefully considered in dimensioning the mechanical parts of the motor, for any dissymmetry in the air-gap may produce a very heavy unbalanced pull, and the air-gap of an induction motor being necessarily small, there would be in large slow-speed motors the danger of the rotor pulling over before coming to rest.

This kind of brake requires a supply of direct current, which will necessitate in many cases the use of a small special motor generator. If it is required, in cases of the supply failing, to lower the load without being dependent on the mechanical brakes alone, it will also be necessary either to use a flywheel for the motor generator or a small accumulator.

* Patent applied for.

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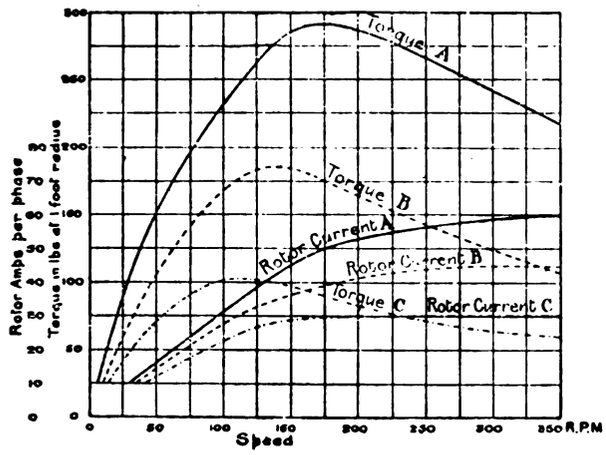

FIG. 12.

In general the curves, representing the relation between torque and speed, have a similar shape to the curves representing the relation between torque and slip in an induction motor working as a motor. There is only a gradual difference, because the curves of the motor are, as a rule, taken for constant alternating voltage on the

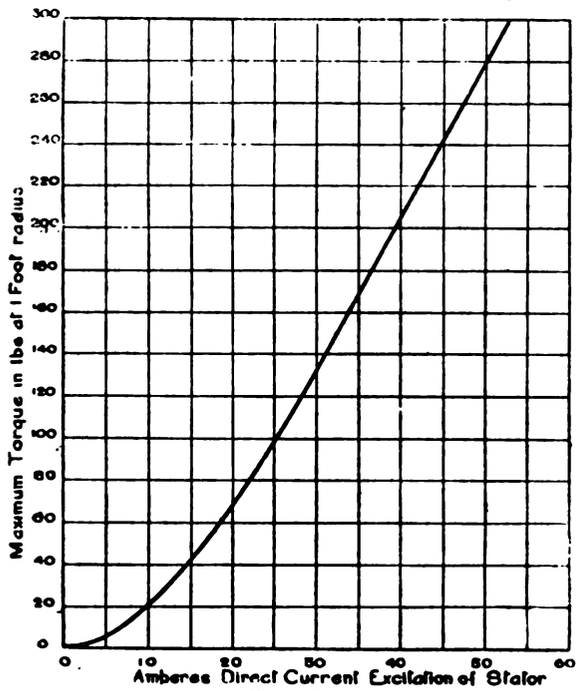

FIG. 13.

stator winding, and therefore the stator current increases with increased rotor current. The reduction of the field is mainly due to the leakage. Here, on the other hand, the stator current is kept constant, and therefore, as soon as the rotor current grows above certain limits, the value of the resultant field diminishes rapidly.

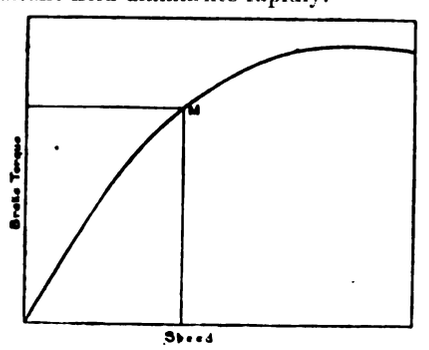

FIG. 14.

We can say that for full load direct current excitation the resultant field at a speed far below the critical speed is much stronger, and at a speed above the critical speed, much weaker than that of an alternating current motor working as such.

EDDY CURRENT BRAKE.

Using the motor itself as a brake with direct current excitation renders it impossible to use, at the same time, the combined effort of the brake and the motor, say, working with a counter-current, and it requires some special switching arrangement for stator as well as rotor. The stator winding must be connected to a controller which allows three different connections: (1) Alternating bus-bars, forward movement; (2) alternating bus-bars, backward movement; (3) direct current bus-bars for braking. Also for the rotor, if ordinarily a liquid starter is used for motoring, a switching arrangement will be necessary to throw a metallic braking resistance on to the slip-rings.

It is sometimes desirable to provide a special electric brake independent of the motor, just as it is usual in tramcars to provide, besides the motor which can be used either with counter-current or as a dynamic brake, also other brakes energised by electric current.

The eddy current brake has often been used as a testing instrument to determine the output of motors and engines. It has been used also for electric cranes to allow of very soft and smooth working. Its application for very large winding engines, which are required under certain circumstances to lower unbalanced loads consisting of men for several hours at a reduced speed, which should never be exceeded for safety purposes, was first (as far as my knowledge goes) recommended by Mr. G. K. Chambers in Johannesburg, and very large apparatus of this description is now under construction.

Smaller forms of eddy current brakes, fitted with copper discs and used for the testing of smaller motors, have been described by various authors, for instance, in a very complete essay by Morris and Lister.* Eddy current brakes with iron armatures have been made by Rieter and Dettmar, who also used such a brake consisting of a simple magnet acting on the rim of a flywheel in order to produce artificial load on gas engines to facilitate the paralleling of alternators to bus-bars.

From the test curves published for eddy current brakes with copper discs,† and from experiments made by myself on eddy current brakes with cast iron armatures.‡ I believe that an essential difference exists between the two. In the brakes as described as Morris and Lister, at first for constant excitation, the torque increases with the speed, but falls after a critical speed is reached. The diagrams have the same shape as Figs. 9 to 12 of this paper, and this is not astonishing, for an eddy current brake with a copper winding on a steel armature represents the same problem as the alternating current motor with direct current excitation on the stator.

An eddy current brake like this used for winding engines would have very serious disadvantages, at least, if the critical speed could not be shifted to a very high value. Morris and Lister's curve now shows the critical speed of their particular brake already at a speed corresponding to a frequency of approximately 35 to 40 cycles per second (8 pole brake approximately 500 to 600 revs. per minute).

In my article of 1902, mentioned above, I have already stated that with eddy current brakes with cast iron armature I was never able to find a reduction in torque with increase in speed, but, on the contrary, a steady increase. The power absorbed by the brake increases at first nearly in proportion to the square of the speed, and even with high frequencies it is still more than proportional to the speed, even up to a frequency of the brake armature current as high as 130 cycles per second (field of 12 poles, speed 1,300 revs. per minute). Fig. 15 shows the steadily increasing torque for two different exciting currents.

Also in apparatus built more recently, I have always found this experience confirmed, and since for practical use this quality is of the greatest importance, the eddy current brakes to be used in connection with winding engines were made with cast iron armatures.

The cast iron armature has, besides great simplicity, rigidity and cheapness, the advantage that the specific resistance of the material is approximately 40 times greater than that of warm copper. As, however, in eddy current brakes, the section of the cast iron is very much greater than the aggregate section of copper windings used in armatures, the different behaviour of the brakes cannot be explained by the increased specific resistance only. My

* "Journal of the Institution of Electrical Engineers," vol. 35, p. 445, 1905.

† Morris and Lister, "Journal of the Institution of Electrical Engineers" vol. 35, p. 445, 1905; also Feussner, "Elektrotechnische Zeitschrift, vol. 22, p. 608, 1901.

‡ "Zeitschrift für Elektrotechnik," vol. 20, p. 353, 1901.

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explanation is, that the virtual resistance of the cast iron armature cannot be considered as a constant value, but that it increases with increased periodicity.

The cast iron armature represents the armature of an alternator with an infinite number of phases, each one short-circuited in itself, although not of negligible resistance. We can assume, however, with certainty that starting from a comparatively low speed the armature ampere turns will be, just as in Fig. 8, not very different from the primary field ampere turns, and therefore the total number of ampere turns cannot increase much with increasing speed. This, therefore, could not account for the observed increase in absorbed power. The power absorbed is made up of three components: friction and windage, which are practically negligible; the C^2R losses of the eddy currents, and the hysteresis losses of the cast iron armature. In an ordinary short-circuited armature the hysteresis losses would be reduced with increased speed, for although the periodicity is increased, the resultant field falls more than in inverse proportion. In an ordinary short-circuited armature with defined path for the current, the C^2R losses also do not rise appreciably after a certain speed is reached. Here, however, I believe that for low speeds the flux penetrates the whole depth of the cast iron armature, and that with increased speed, and therefore increased voltage per inch axial length, the current density near the surface increases, and that this surface current opposed to the primary flux shields the deeper parts of the armature, so that fewer and fewer lines of force penetrate and the currents crowd more and more

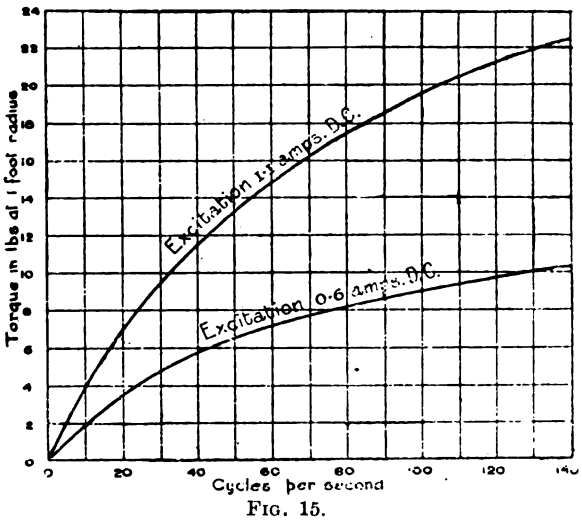

FIG. 15.

on the skin of the armature. Therefore, with increasing periodicity, the resistance of the eddy current path increases, and this also has the effect that the resultant flux does not tend to fall off, since in order to maintain the current with the increased resistance, a higher E.M.F. is required. Of course, owing to the crowding of the magnetic lines on the surface, the hysteresis will be increased if the total flux is not reduced with increased speed, for considering that hysteresis is not simply proportional to the induction, but to its 1·6th power, every uneven distribution of the induction must needs have the effect of increasing the hysteresis, and also, of course, the increase in frequency means increased losses. But in general, I do not believe that the hysteresis losses are the most important even at high frequencies.

If we assume that windage and hysteresis losses can be neglected, then the observed fact that not only the absorbed power, but even the torque increases with increased frequency, would give us a basis for our theory already expressed above.

1. The volume of current in the armature remaining practically constant above a certain speed, there is no other explanation for the increased power consumption than the increase in apparent resistance.
2. The volume of current remaining practically constant, there is no other explanation for the increased torque than an increase of working flux, and not a decrease as usual.

Assuming that the eddy currents are only skin deep (the word "skin" taken in a very wide sense), I figured out, from test observations on different apparatus, built during the last 10 years, the depth of the working skin. The calculation is a bit rough, but it will be sufficient for the comparison of different apparatus, and also for calculating the performance of newly designed apparatus.

I assume that, under each pole, currents will flow, the aggregate of which is nearly equal to the ampere-turns of the said pole. Considering that the field winding is a coil winding, each turn surrounding the whole pole, whereas the armature currents are distributed on the surface, the latter would have to represent a bigger aggregate if their value were allowed to grow till they completely neutralised the field ampere turns. If, therefore, we accept them as equal, the error will not be very great. We assume that they are confined to a part of the surface equal to the peripheral dimension of the pole plus a certain fringe. The currents will change their direction before they reach the centre of the pole, because the cross-magnetising component of the armature reaction reverses the polarity of the leading pole-tip. That is to say, a pole which by its field coil is so excited that with stationary armature it represents a north pole, with an average value of, say, 10,000 C.G.S. lines per square centimetre, will, with the eddy current brake rotating, show south magnetism in the leading pole-tip, north magnetism in the greater part of the pole. The average value will perhaps be 2,000 lines of north magnetism.

If we assume that the armature of the eddy current brake is wider than the field poles, the distribution of the currents will be similar to that in Fig. 16—that is, we shall have currents flowing similar to those in a proper single-phase drum winding with concentric end connections. If the armature is not wider than the pole-shoes, we can imagine that the end connections are bent down, and that the current flows at the front end of the rim from one part of the path to the other. We may approximate for our calculation the average length L of the current path. If we now call R the resistance of the skin, viz., of a straight current conductor of a width b, an unknown depth x, and a length L, and if we, in order to simplify calculations, assume that the number of ampere wires are equally distributed along the width b, and represent in toto $2\,ni$ ampere wires (ni being the number of ampere turns per pole), and if it be observed that for the whole brake with $2\,p$ poles the power consumption in watts after deduction of losses for friction and windage is W, then we have the simple equation—

$$C^2R = \frac{W}{2\,p},$$

$$(2\,ni)^2 \times R = \frac{W}{2\,p},$$

and this will give for the observed values of excitation and frequency the depth x of the current carrying skin.

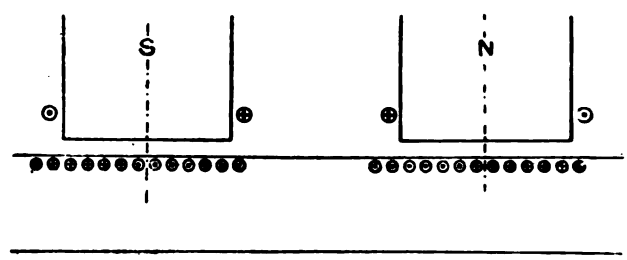

FIG. 16.

The eddy current brakes as used in connection with large hoisting engines are able to deal with continuous service, that is to say, with continuous trips of unbalanced loads of men or material from the surface to the bottom of the pit, and it is possible to regulate the speed without use of the mechanical brake down to a very low value. The field is excited from direct current bus-bars which are fed by a motor generator and on which a storage battery is floating; therefore the brake is also available in case of failure of the main supply current, and in such cases the excitation is switched in automatically.

The eddy current brake in another form can be used to make the Ward-Leonard braking method also available if the Ward-Leonard motor generator or the engine driving such generator has a comparatively small flywheel which for lowering of the load during a long trip would speed up dangerously. In such cases it will be sufficient to fit a stationary pole of small dimensions opposite the flywheel rim and so induce eddy currents in the flywheel which consume the power supplied into the flywheel set.

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I have confined myself in this paper to merely one question in the great chapter of electric winding engines which represents now, and will represent more with every coming day, one of the most important chapters of the application of electrical power for industrial purposes.

It would be futile to ask which of the systems described is the best system of electric control. The answer might be in favour of any one of the systems according to the circumstances of the case. In one case, the greatest importance might be attributed to the lowest possible power consumption, and if the starting periods and the braking periods and the periods of trips with reduced speed are of long duration, the Ward-Leonard system might prove the most efficient one. With different starting and running conditions the simple alternating current motor system might be the most efficient in power consumption, and in other cases it might be preferred on account of its lower initial costs, even if, owing to the given conditions, the power consumption for the shaft horse-power works are higher. The power consumption will be of greater importance the higher the price of the kilowatt-hour in the particular case, and will, therefore, depend upon the local price of coal and labour. As to the question whether the current consumption or the capital expenditure should be kept low, it will prove a decisive factor whether the shaft in question is intended to be worked for many years, or whether the working will cease presumably after a few years' time.

If power is taken from a supply company, the selection of the system, and the question whether equalising apparatus should or should not be used will greatly depend upon the method of charging for the current consumption. If current is charged on a flat rate basis, an equaliser would, in general, be out of place, because it not only increases the initial costs, but also, owing to the inevitable losses, the total current consumption. A charge on the maximum demand system, on the other hand, will turn the balance in favour of equaliser systems. The question also whether any inducement is offered to the power consumer for a good power factor might turn the balance in a given case from the direct coupled slow speed alternating current winding motor to the Ward-Leonard system with high speed motor generator. Safety apparatus which, in one case, due to the local conditions and regularity of the supply, would seem an unnecessary luxury, will be of vital importance in other cases.

So each of the systems has its own merits which will call it to the front according to the circumstances of the case.

Discussion.

Mr. J. S. Peck (Chairman) said there had been several papers dealing with the subject of electric winding, from different standpoints, but this was the first paper devoted entirely to the control and braking of electric winding and hoisting machinery. There were two methods of braking in use: counter currents and mechanical. Whether the eddy current brake was justified or not, it was a formidable addition to the equipment. It, however, provided triple protection.

Mr. W. Cramp said that besides the Ward-Leonard system and theostatic control, there was another method possible. He thought the application of some system of cascade connection between the motor and generation with means for charging the number of poles as in Mr. Hunt's motors would result in efficient control. Another means which suggested itself was the use of a heavily over-compounded motor. By cutting out the shunt it could be braked as an ordinary traction motor.

Mr. Seaton said he had been surprised to find on the Rand how very much more up-to-date mining practice was than in England. They were adopting electric winding and rapid extensions were expected, but here, apparently, there was no immediate prospect of great development.

Mr. J. Frith said he had used eddy current brakes with the iron construction. He had found them very flexible. His tests, too, showed that the torque increased with the speed. His explanation of the difference in effect between eddy current brakes of the copper and the iron constructions was that in the iron construction the path of the eddy currents was so very undefined. He had experimented by slotting the iron and winding in the slots, to keep the path of the eddies constant. The result was very nearly that of the copper disc type. He had also found that copper end rings on a cast-iron ring gave results intermediate between the ordinary copper and iron types. In braking induction motors by putting in direct current, he had found that the best effect for the least loss was got by putting the current in at one phase and taking out at other two phases.

Mr. S. J. Watson said he had been considering what would be the effect on a generating station if a dozen collieries were to take current from it for winding. Supposing they all happened to get into step, it would mean a load of some 18,000 kw. maximum sinking to zero in about 1¼ minutes. This was a severe set of conditions to meet, and appeared to be only good as a test for voltage regulation and engine governors.

Mr. Ferguson said he thought the counter current brake control would appeal to the steam engine driver, because to lower, you raised. The Ward-Lenardo system had no load running losses going on between winds and came out very inefficient on long winds.

Mr. Mallison thought colliery people would be opposed to eddy current brakes. Where large units were considered, direct current winding was more efficient.

Mr. Stevenson, dealing with the question of returning power to the line, did not think power stations would welcome this. He mentioned the case of a rolling mill motor which was returning power to the mains, where the supply people put a ratchet on the meter. He considered the three-phase motor would be the final thing in winding work. His experience was that collieries would not go to the expense of installing Ilgner sets.

Dr. Rosenberg (in reply) said regarding the use of single-phase commutator motors, to which Mr. Cramp had referred, the objection was not to the commutator itself, but to the motor. So far they had not been used for the work. They were more expensive and less efficient than direct current or induction motors. The traction single-phase motor was also less efficient, but in that case the deficiency was balanced. In the case of the winding engine application it would not be. Mr. Cramp's suggestion of a cascade winding was theoretically possible, but not wise in practice. Regarding the employment of a heavily over-compounded motor, there would be no gain in this. The advantage which in any case was small, would be quite overbalanced by the ranging condition of the load during the wind. Even the weight of the rope would cause the speed to vary during the journey. He had found that the amount of power required was exactly the same, whether it was put on direct or distributed between the phases. It was necessary to copy the three-phase field at any instant, hence his connections. He would like to have heard if Mr. Frith's copper and iron brakes had increased the capacity of the magnets.

BOMBAY'S HYDRO-ELECTRIC SUPPLY.

The Tata Hydro-Electric Company, Ltd., has been registered, with a capital of 175 lakhs, made up as follows: 55 lakhs debentures, 5½ per cent.; 60 lakhs preference shares, 7 per cent.; and 60 lakhs ordinary shares.

Power will be transmitted 43 miles to Bombay, where the pressure will be suitably reduced for a general supply. The conditions are considered most favourable and the power market exceptional. Several Indian chiefs are taking a large interest in the project, including the Gækwar of Baroda, and the Maharajas of Mysore, Gwalior and Chavnagar. Sufficient capital is already pledged to start the enterprise. All of this has been privately subscribed, but if further requisitions come in a larger project may be undertaken with a capital of 250 lakhs. The Governor of Bombay is giving the scheme his most hearty support. The directors are Sir Dorabji Tata, chairman; the Hon. Sir Sassoon J. David, Mr. Shapurji B. Barucha, Mr. R. D. Tata, Mr. Prabshankar Pattani, the Hon. Mr. Lallubhai Samaldas, the Accountant-General of Baroda, and Mr. H. J. Bhabha, of Mysore. Mr. H. Parker Gibbs, M.I.E.E., Chief Electrical Engineer, Mysore Government, is acting for Messrs. Alfred Dickinson & Company, the engineers, and Mr. Joyner will have charge of the hydraulic department.

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GLASGOW LOCAL SECTION OF THE I.E.E. ANNUAL DINNER.

The ninth annual dinner of the Glasgow Local Section was held at Glasgow on December 14, when Mr. Sam Mavor, chairman of the section, presided over a company of fully 200, including Mr. S. Z. de Ferranti, President of the I.E.E.; Mr. W. H. Patchell, member of the Council of the I.E.E.; Mr. T. Harding Churton, chairman of the Yorkshire Local Section; Sir Hugh Shaw Stewart, Sir John Ure Primrose, Professor A. Barr, Bailies A. Campbell and Willock, Mr. H. W. Clothier, hon. secretary of the Newcastle Local Section; Principal Sir Donald Macalister, Messrs. H. A. Mavor, W. W. Lackie, E. G. Tidd, J. A. Robertson, and J. E. Sayers. Messrs. H. A. Mavor, J. A. Robertson and E. G. Tidd were the croupiers. An apology for absence was received from Mr. G. H. Wordingham, of the Admiralty.

The loyal toasts were duly proposed and honoured.

Professor Barr, in proposing the Imperial Forces, said that in Mr. Wordingham's absence he would take the liberty of stating that while there had been advance in all branches of the service, the electrical side was the one which had shown the most definite advance. Mr. Wordingham had effected quite a revolution in the equipment of their ships. It must be a great source of gratification to electrical engineers, who were concerned more with the arts of peace, that one of their number had been able to effect such a mighty change as they knew had been effected in the electrical equipment of the Navy.

Sir John Macdonald, in replying, said their ships were crammed with all sorts of electrical apparatus, and a captain nowadays had to possess considerable electrical knowledge.

No doubt electricity would be of great use in the army.

Sir Hugh Shaw Stewart proposed "The Corporation of the City of Glasgow." He said he had great respect for what electricians had done in the past, and he was sure they would do still more in the future. He would not be surprised if they managed yet to generate energy from the heat of a General Election. Whenever the Corporation of Greenock, of which he was a member, came before the ratepayers and mentioned the Electricity Department the ratepayers smiled, because their electrical undertaking was paying well. Since 1892, when they started their Electricity Department, the Glasgow Corporation had proved that by doubling their capital they quadrupled their output. Their greatest advance was in the power side of the business. Since the Smoke Abatement Exhibition, a few months ago, the Glasgow Corporation had electricity supply within the reach of all for heating and cooking purposes. This touched the question of the City's health, apart altogether from the question of whether it paid or not. In Glasgow they had already displaced 70 great boilers, each of which had had its own chimney belching forth the products of combustion at various points in the City. If the Corporation went on to encourage the use of electricity for heating and cooking they would also diminish in the same proportion the output of smoke from the domestic chimney.

Bailie Archibald Campbell, in reply, said that their Electricity Department had started with a capital of £18,000; to-day their capital was £2,250,000. Their revenue last year had been £260,000. They had two large generating stations, and they had bought 10 acres of ground for a third station. Their price had fallen from 7d. per unit fo 2½d. for lighting, and under 1d. for power. Their power load meant that over 60,000 tons less of coal per annum was consumed in small boilers. Their total motor load ran to 33,000 h.p. They looked to the Electricity Department to be a great contributor in the solution of the smoke problem.

Sir Donald Macalister, in proposing the Institution of Electrical Engineers, said that the Institution had already 40 years save one of vigorous and successful existence, and it had over 6,000 members and associates. Lately it had acquired a local habitation of its own in the stately buildings on the Victoria Embankment. The qualifications and diplomas of the Institution were now recognised as testifying to high proficiency in their profession. Electricity penetrated into every part of their domestic and civic life. He only wished it could penetrate further and abolish the domestic fireplace. They were still profoundly ignorant of the nature of electricity, but a man must have risen very high in the electrical profession before he could say straight out that he did not know any more than Lord Kelvin did. He coupled the toast with the name of Mr. de Ferranti.

Mr. S. Z. de Ferranti, who had a very hearty reception, said that what must have struck them all in thinking over their work was the development that had been made. Glasgow had done much towards this. The time was coming, however, when not only electrical engineers, but all engineers would find it difficult to get along without a considerable knowledge of electrical engineering. Their Institution had risen from small beginnings very rapidly to its present position, and the increase of membership was continuing at an increasing ratio. Their Institution would ere long be in the front rank among the scientific societies of the world. Their Institution would, however, only be what they made it, and they must all do their utmost to make others feel that membership was a thing to be valued. Recent developments had necessitated the Institution moving forward. They felt that the time had come when they must assist original research in electricity. They felt that in the spirit of the time they required to work co-operatively.

Mr. Patchell proposed the Local Section, which, he said, was officially announced exactly 11 years ago that night. Their first chairman had been the man who for 50 years was the representative head of the electrical industry—Lord Kelvin. Theirs was the only Institution that had six local sections, viz., Manchester, Birmingham, Yorkshire, Newcastle, Glasgow and Dublin. The average membership of the sections was 360, and he was surprised that Glasgow had only 343 members and 61 students. He coupled the toast with the name of Mr. Sam Mavor. The Local Section had gone twice to the Mavor family for its chairman. Mr. Sam Mavor's work was well known both above and under ground, and his firm had been pioneers in the industry.

Mr. Sam Mavor said they had to thank the Institution for the presence of Mr. Ferranti and Mr. Patchell at their dinner. The system of supply advocated by Mr. Ferranti long ago for Glasgow had now been adopted.

The local section recruited its membership from students, members from other parts of Scotland, and members coming from south of the Border. He thought that if their section was called the Scottish Section it would make a larger appeal. They were always glad to see Englishmen in their midst. They gave them honorary posts and got useful work out of them. His predecessor in the chair and their present secretary were both Englishmen. He thanked them for the manner in which they had received the toast.

Votes of thanks, proposed by Mr. J. A. Robertson, of Greenock, closed the proceedings, which were of a most enjoyable nature throughout.

DAMAGES AGAINST A BOROUGH.

In the King's Bench Division, before Mr. Justice Grantham and a special jury, Mrs. Elliott sued the Battersea Borough Council for damages for personal injuries.

On October 29, 1909, she was standing at the corner of Latchmere-road and Battersea Park-road, and was resting her hand upon an iron box fixed in the pavement while she watched smoke issuing from the roadway. The fire brigade was coming along the road. Suddenly the box on which she had placed her hand was blown open. Her clothes, hands, and face were burnt. First aid was rendered to her by an officer of the fire brigade. Subsequently it was found that she had sustained serious internal injuries, likely to be of a permanent character.

The defendants denied negligence, and said the accident was incidental to the use of electricity. It was due to a London County Council workman, who while engaged on tramway work injured the casing of an electric lighting cable and let in the damp.

The jury awarded the plaintiff £525 damages. Judgment was entered with costs. A stay of execution was refused.

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PUBLICITY.

Success invariably induces competition, which in its turn brings about the necessity for fresh endeavours, without which prosperity is short-lived. This is certainly true as regards the work of central supply stations. At first regarded with tolerant pity, electric lighting soon made such rapid strides that it aroused jealousy and a certain amount of violent if random criticism. But while gas interests were vilifying electricity, they were also putting their own houses in order, and it must be confessed with very beneficial results. The stimulus given by electric lighting competition has undoubtedly brought about vast improvements in gas illumination, with the result that wavering customers have been retained and some lost ones regained. This has naturally heartened up the gas people, and while the engineers have been improving manufacture, but more particularly distribution and methods of burning, the commercial managers have been showing markedly capable judgment in initiating an extensive plan of campaign, supported by many clever skirmishes. The whole thing is well conceived and thoroughly carried out. It is necessary for the electrical industry to meet this campaign, which for some time past has amounted to a direct attack. Steps must be taken to bring the real advantages of electricity before the public, the consumers, whose attention must be caught and reasoning faculties convinced. This can only be done by fairly extensive, but, above all, systematic advertising. Showrooms, posters for hoardings, leaflets containing carefully digested and telling facts, and general newspaper announcements must all be enlisted in an organised plan for educating householders both great and small. Much is already being done by various branches of the industry, and not least by central stations, whether owned by companieso r ratepayers. But more remains to be done, and the closer the different interests are in touch, the more each effort

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is made to fit into a general plan, the better the work will be done. We have made such progress that it should be easy to make further converts among a discerning public. Nevertheless, it should be recognised that very large sections of the community still remain in comparative ignorance of all that electricity means in the health, comfort and economy of the home. These sections of the community are being appealed to by other business men, and it is for the business men of the electrical industry to see that effective counterblasts to such appeals are issued.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

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Under the above heading we insert questions of a practical character relating to power stations, electrical railways, and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

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ANSWERS.

Question No. 1236.—Mention the points controlling the design and operation of "*surge tanks*" in hydro-electric schemes. Are such tanks essential? Also, what dangers attend omission thereof or wrongful design? Give practical design rules if possible.

Answer to Question No. 1236 (*awarded* 10s.).—A surge pipe or tank may be regarded as a buffer or reservoir, according to circumstances, which resists any abnormal pressure rise in the case of a reduction in the demand of a hydraulic station or aids in the smart provision of any increase in output. The device is only necessary where water power is conveyed through a closed pipe line, but is then essential in all but a very few cases. The surge pipe or reservoir is a vertical or upwardly inclined offshoot from the base of the conduit line, and may be open to the atmosphere at the top or may lead into a compressed air chamber. In the former case a water-head, practically equal to that of the "pond" from which power is drawn, must be provided, but, by the use of compressed air, a certain artificial ("air-head") pressure is employed (air at 200 lbs. per square inch equals 462½ feet head of water).

Suppose a water turbine plant be supplied with power through a long closed conduit: the kinetic energy and inertia of the water column in the latter is very great, and it would be dangerous to suddenly close a valve at the bottom of the line, while, on the other hand, were such a valve suddenly opened to a greater extent, it would be an appreciable time before the water column would assume the required higher velocity. It is the function of the surge pipe or tank to cope with both of these adverse conditions. By providing a *potential* energy storage it absorbs or aids in the provision of *kinetic* energy, as may be required.

In very short lines of medium slope a surge tank may be dispensed with, but in general its omission would lead to fracture of the lower end of the conduit line on the sudden rejection of a load, and would involve very sluggish response to load increments. In such cases the only alternative to the surge tank would be wasteful bye-pass regulation (constant total flow, but only partial utilisation thereof on light loads). Bye-pass regulation should never be tolerated on a closed-conduit system, though it may be adopted on those open lines from which overflow would in any case be inevitable on light loads. Wrongly designed, a surge tank may be worse than useless (see below).

Action of Surge Tank.—Consider the mode of action of a simple stand-pipe (vertical or inclined) type of surge tank: let the pipe be located quite near the turbine

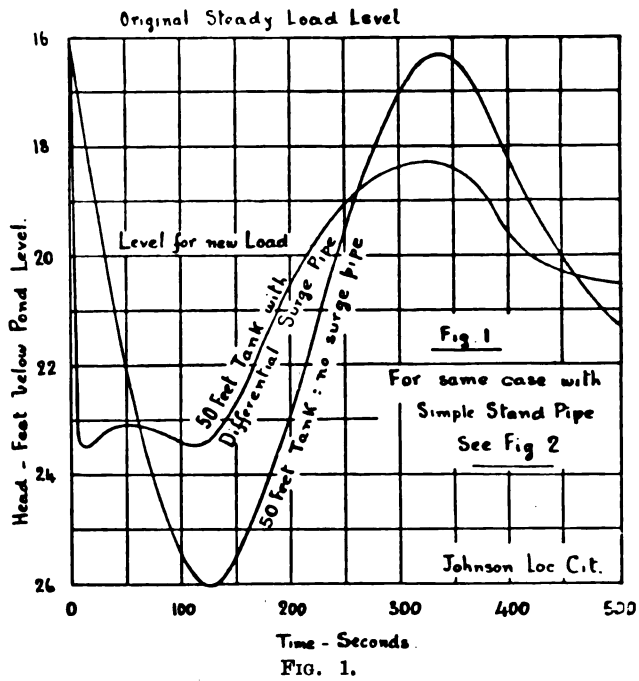

FIG. 1.

"gates," then the level of the water within it equals (the "pond" level — the frictional head of the conduit) and sensibly equals the effective head on the turbines.

1. More power is demanded by the turbines: the "gates" are opened by the governor, and the water in the conduit begins to accelerate but very slowly. The water in the surge pipe, however, runs down comparatively rapidly and thus decreases the head at the base of the conduit.
2. The reduced base pressure is transmitted back along the conduit at about 4,500 ft. per sec. and a very rapid velocity acceleration begins.
3. The velocity, thus increased, soon satisfies the additional power demand, and commences to restore the stand-pipe water level: when the latter is reached, however*, the water still has an acceleration which cannot at once be destroyed.
4. The stand-pipe level therefore continues to rise till it is as much above its steady level as it initially sank below it (neglecting the damping effect of friction). The level then falls again, and (the load remaining steady) continues to oscillate about its mean position for a time determined only by the frictional resistance of the stand-pipe. To this *surging* action the pipe owes its more expressive name.

Theoretically the water oscillates precisely like a simple pendulum of length equal to that of the conduit: the friction which actually exists seldom varies the period of vibration more than 10 per cent. from its theoretical value and the frequency is almost independent of the magnitude of the load variation; the time of oscillation is, in fact, almost a constant for each pipe system.

The above does not allow for the effect of the turbine governor. When the increased demand comes on the governor opens the "gates" and thus accentuates the initial fall of the stand-pipe level: as the latter is restored the "gates" are closed somewhat by the governor and the rise is therefore further increased, beyond that due to the inertia of the too-fast moving water in the conduit. It thus follows that the governor tends to set up surges of *ever increasing amplitude* (Fig. 2) and though friction always opposes this tendency *it may be insufficient to completely overcome it*: chance coincidence of load variations with the surges already existing may further aggravate matters. The action of friction is to increase the amplitude of the initial fall in the stand-pipe, but, if the latter be properly designed, the decrement is thereafter rapid (Fig. 1). Improperly designed, however, the frictional resistance will not suffice to damp the surges quickly

* It is only so much below its original levels as is required by the extra friction drop in the conduit, due to increased velocity of water.

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enough and may even fail to prevent cumulative surging. Under such conditions, a surge pipe is worse than useless.

On long lines (particularly if over one mile in length), the design of surge pipes must be very careful for the above reasons: on short lines, however the kinetic energy to be absorbed is less, and a small stand-pipe (even considerably smaller than the conduit) provides all the "buffer" action required and does not surge cumulatively because the comparatively light bulk of conduit water is accelerated before the inertia of the turbines and their load allows the governor to start its pumping action.

Actual design rules for surge pipes (particularly of the differential type) (see below) are very complex and cannot be treated satisfactorily here. The reader may refer to an excellent exposition on the subject in "American Institution Mechanical Engineers," June, 1908, p. 833, et seq. Tedious plotting of the surge pipe waves may be necessary in doubtful cases to make certain that the oscillations do not reach *excessive amplitude* and do actually *die out*.

In the case of a simple stand-pipe the rise in pressure, on rejection of a load, is absorbed by an upward surge of the water level in the pipe; the level ultimately coming to rest, somewhat above its previous position, after a series of oscillations similar to the above.

As a rule, sudden decreases in demand are far greater than sudden increases, and hence, and because "water-hammer" involves risk of *damage*, whereas slow acceleration only means slightly less satisfactory working for the time being, the provision of pressure safeguard is the more important (though smart acceleration is highly desirable).

"*Differential*" *Surge Tanks.*—In the "differential" apparatus a stand-pipe of small bore rises inside or parallel to the main tank and communicates with the latter only through small ports (or a bye-pass) at the bottom. The water in the "riser" is "pressure" water; that in the

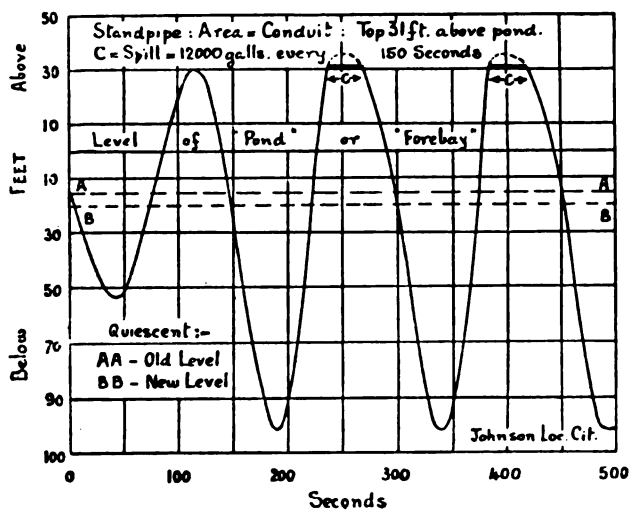

FIG. 2.

main tank "stored" water. On a sudden load demand the level in the inner pipe rapidly falls sufficiently to give the required acceleration and is then kept stationary at this value by inflow from the outer tank; the difference between the two gradually decreases, vanishing only when the requisite higher conduit velocity is attained. The inner stand-pipe alone would not have sufficient capacity to supply the extra demand, at least, without excessive head variations. Actually, however, the variation in head is only that required to draw extra water from the outer tank through the restricted ports (the resistance of the latter making the effective heads of the outer and inner tanks equal). Acceleration is very rapid and the reservoir area is only some 50 per cent. that of the equivalent simple stand-pipe; moreover, in the latter the level of the whole of the water must fall to give a certain acceleration, whereas a sufficient accelerating head is reached practically instantaneously in the differential system. The danger of cumulative surging is very slight in differential surge tanks; also, the differential system vastly improves the operation of compressed air surge reservoirs.

The "head" (whether natural or artificial) of a surge tank must be equal to that of the "pond" minus the frictional loss of head in the conduit, and, in general, the tank must be carried so far above this level as will permit all likely surges without spilling from the top of the sorge vessel. It is in the choice of an appropriate tank *area* that the difficulties and mistakes of surge tank design are generally made.

The weight of water contained per foot of head of the tank determines the reserve capacity of the latter so that an inclined pipe holds more "storage" water than a vertical pipe of the same bore and total head. A minimum tank area is desirable for cheapness and ease of erection, but the ratio of the conduit to the surge pipe area must not be too great, particularly on long lines of gradual slope. If the line is of more than one mile in length, or less than 1 in 16 in slope particular care in design is necessary. The larger the stand pipe area the less the fall in head (on sudden load demand) before the new velocity is attained and the less the variation in pressure felt by the turbines but whereas a small surge tank is liable to pumping or cumulative surging, a too large tank is sluggish in action and unduly expensive.

The area of the outer tank and the communicating ports in "differential" apparatus must be such that the outer level reaches the inner level by the time the new conduit velocity is gained; the ports, properly designed to enable the supply of an increased demand, must be (and usually are without further trouble) small enough to offer sufficient resistance to the surplus kinetic energy thrown idle by suddenly decreasing the load. A well designed differential surge tank will absorb the shock of a sudden complete rejection of full load and will enable transition from zero to full load with no more than 10 per cent. temporary variation of head at the turbines (the latter being a test figure on a 5 ft. line, one mile long, water velocity 8–10 ft. per sec.).

Surge tanks should always be located as near the power-house as possible, and if high ground lies near by it should be utilised in the erection of the surge plant. Otherwise it may pay to have an atmospheric surge tank at some distance from the power-house and taking advantage of geographical contour, this tank being aided if necessary by a small auxiliary compressed air surge tank near the power-house. If no suitable site for an atmospheric surge tank is available it may pay to have a full capacity compressed air surge standard near the works. The compressor will only be called upon to make up for leakage and absorption of air by the water; an air pressure of 200–250 lbs. per sq. in. is often employed. Compressed air surge apparatus works far better on the differential (than on the ordinary system) and it is now advisable to replace the inner "riser" and its ports by a short upward nozzle with a restricted and carefully designed mouth aperture. Such a nozzle may be employed on atmospheric differential surge tanks, but the form described above is preferable.—"HYDRO."

PRICE LISTS AND CATALOGUES.

We have received the following trade publications:—

The North-Western Electrical Appliances Company, Glasgow: (1) The "N.W." Arc Lamp Leasing Gears and Winches; (2) Arc Lamp Safety Winch No. 7 (both illustrated); (3) Large lithographed sheet of arc lamp lowering gears, winches and accessories.

Wallach Bros., Ltd.: Alison-Broadhurst Patent Filling Apparatus.

The Electric Construction Company, Ltd.: Electric Driving in Textile Factories.

Merryweather & Sons, Ltd.: Illustrated leaflet of "Improved Electric Motor Fire Engine."

Pinchin, Johnson & Company, Ltd.: Descriptive list of "The Standard" Insulating Specialities.

Crompton & Company, Ltd.: Pamphlet 25, on "Arc Lamps, Enclosed Type," fully illustrated.

ROYAL INSTITUTION.—On Thursday next, December 29, at 3 o'clock, Professor Silvanus P. Thompson will commence the Christmas course of six juvenile lectures on "Sound, Musical and Non-Musical"—a course of experimental acoustics.

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Electrical Progress at Home & Abroad.

Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

Business men on Tyneside and in the district are heartily glad that the long-continued boiler-makers' lock-out has come to an end. It is now anticipated that there will be a period of brisk business and prosperity, although it will take some time before orders will filter through the firms interested in such subsidiary apparatus on board ship as electric light and power installations. The return of the men to work, however, means that the shipyards on the Tyne will be taking their full amount of electrical energy from the power supply system; which is a point to the good. The number of orders for ships already in hand, both on the Tyne and Wear, is, however, very encouraging, among these being a vessel for the refrigerated meat trade, to be built by Messrs. Palmers, a considerable number of merchant vessels to be built by such firms as the Northumberland Shipbuilding Company, Ltd., etc.; while it is rumoured that the British Admiralty has orders to give out for three more battleships of the Dreadnought class. It is hoped that at least one of these will come to the Tyne.

New Tariff for Sunderland.

The Sunderland Corporation, in common with many other electric light and power authorities, has for some time past been considering the question of tariffs for general supply. This is a healthy sign, as showing that the small consumer is not being altogether ignored in the rush after large power business which is being made nowadays. I am permitted to quote from the recommendations of the Electricity and Lighting Committee as follows:—As regards private houses the present rates can be continued at the option of the consumer, but alternatively electricity may be supplied for any domestic purpose where the premises are lighted throughout by electricity, 80 per cent. of the lighting being by metal filament lamps, on a fixed rental basis including meter rent, plus ¾d. per unit metered. For dwelling houses the rateable value of which is £15 to £30, the rental is 10 per cent. of the rateable value per annum; above £30 to £40, 11 per cent.; above £40 to £50, 12 per cent.; above £50 to £60, 13 per cent.; above £60 to £70, 14 per cent.; and above £70, 15 per cent. This percentage may be varied where the assessment is influenced by causes that do not affect the use of electricity. The fixed charge is to be allocated between the two summer and the two winter quarters in the proportion of one-sixth for each summer and one-third for each winter quarter. In offices and banks the present rate is continued together with the alternative that premises lighted electrically throughout (*i.e.*, electricity used to the exclusion of gas for lighting purposes) and using not less than 70 Board of Trade units per annum per 100 watts may be charged 3d. per unit. A special alternative scale is also offered to shops, warehouses, workshops, theatres, concert rooms, picture halls, etc., where these are electrically lighted throughout, and for new consumers, the present maximum demand scale is to be discontinued.

The Newcastle Corporation and Electricity.

The Newcastle City Council has been engaged in considering the Parliamentary Bill whereby it is proposed to obtain powers to spend over £106,000 to effect tramway extensions in the city area, to run a line of cars to Newburn, and to operate railless electric omnibuses or other conveyances. The extension to Newburn was the subject of some considerable discussion, on the ground that extension beyond the boundaries of the city involved harm to the ratepayers. It was, however, decided to go forward with this portion of the scheme.

The Newcastle Corporation are also parties in a case in the Chancery Division where the plaintiffs, the Newcastle-on-Tyne Electric Supply Company, are raising the question of the working or lighting of the cars in Walker, arguing that the Corporation are not entitled to supply electric energy for this purpose. From the local reports of the case (vide "North Mail") it appears that the whole question turns upon the construction to be placed on some Acts of Parliament, Provisional Orders, and agreements, the defendants' position appearing to be that the Walker Council had powers given them to supply electricity in their own area, which they had delegated for a certain period to the plaintiff company, and that after August 6, 1910, the Newcastle Corporation had the right to supply their own tramway system etc., with power and light.

The Institution of Electrical Engineers.

On Monday, the 12th inst., the conclusion of the adjourned discussion on electric winders was reached, so far as speaking was concerned, although several vexed questions still seem to remain unsolved. The meeting was remarkable from the fact that not only electrical engineers, but mining men, took part, thus enabling the discussion to assume a broader aspect. Mr. T. Campbell Futers, a well-known colliery expert, opened the proceedings by a description of the various methods of winding in existence and their bearing upon electrical work. His opinion appeared to be that at present electric winding could hardly be ranked as equally competitive with steam winding from a cost point of view, and that where electric winding was adopted by a colliery having a good load factor and a sufficient capital to spend on electric winders, they should generate their own current. Mr. F. Anslow wrote from Glasgow, giving interesting particulars of two electric winding plants put down by his firm. Mr. Matthew Kirby, a local colliery engineer, gave same actual working costs of two steam winders in the Newcastle area which were much appreciated. Mr. H. A. Couves put the case for electric winding from a centralised power supply. Mr. J. S. Schuil drew attention to the use of buffer batteries in mining installations of limited generator power, while Mr. W. C. Mountain added to his previous remarks by quoting some figures just given by Mr. Hudspeth before the Institute of Mining Engineers regarding some German electric winders, and comparing them with some steam winder data which he had himself obtained. Mr. J. G. Wilson then replied to the whole discussion, pointing out that this had strayed somewhat from the original scope—that of a comparison of different types of electric winders under different conditions—to the rival advantages of steam and electric winding, which Mr. Wilson argued was a question incapable of general settlement so soon after the introduction of electric winding.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The discussion of Mr. Hadyn Harrison's paper on "Street Lighting by Modern Electric Lamps" last week by the Birmingham Local Section of the Institution of Electrical Engineers was quite opportune, as there are now going on in the city some important experiments in street lighting with high pressure gas. Although Handsworth and some other authorities in the district have made experiments with electricity for this purpose, the lighting of the Birmingham streets has been left hitherto to the Gas Committee. High pressure mains and special compressing stations have been provided in the central parts and during the last week or two high pressure lamps

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on tall standards have been substituted in one or two prominent positions for lamps of the old style. The high pressure supply is intended also to serve some of the Birmingham industries and to boost up the ordinary supply of gas where required, and so much importance is attached by the Gas Committee to this departure that Mr. E. W. Smith, who has been engaged at Leeds University in gas heating research on behalf of the Institution of Gas Engineers, has been appointed special adviser in this department, and is about to take up his residence in Birmingham. The comparisons between electricity and gas for street lighting given in Mr. Harrison's paper will, therefore, form most useful data for those both on the gas and on the electrical side who are interested in watching the development of this Birmingham scheme.

Theory and Practice.

The discussion upon Mr. Harrison's paper last week was one of the most spirited the Local Section has had, and though compliments were freely forthcoming, there was much keen criticism of Mr. Harrison's methods of comparison. The point which seemed to excite liveliest interest was the success Mr. Harrison had attained in Marylebone with his method of reflection. In explaining this, in the course of his abstract of the paper, Mr. Harrison described the form of reflector ultimately adopted as not being theoretically correct. The rejoinder made by Dr. Sumpner, Principal of the Birmingham Technical School, was that if the shape regarded as theoretically correct proved not to be the right one in practice the theory was obviously wrong. As Dr. Sumpner explained, what had to be considered was not the ordinary law of reflection depending upon the angle of incidence, but the law of diffusion from a certain kind of surface. And what had to be chiefly considered was not the angle of incidence, but the direction in which the light was to be thrown. Mr. Harrison, who, at the request of Mr. Solomon, at the opening of the discussion, sketched on the blackboard the curve of the reflector adopted, stated in reply to a question that the material was enamelled zinc. He further stated that in any matt white surface, or anything approaching to matt, a very slight difference in texture made a great deal of difference to the manner and the efficiency of the reflection. For instance, if the coating were applied by hand the direction in which the brush was applied would materially affect the angles at which the rays were thrown off. He found that uniformity was best secured by a vitreous enamel as the stoved surfaces were much more uniform in character.

Reliability of Rival Data.

The comparisons set out by Mr. Harrison in his tables and diagrams came in for a good deal of criticism, especially his comparisons of electric lamps of different consumptions, or supplied with different amounts of current. A question came up also as to the comparison of flame arc lamps and magazine arc lamps, one speaker pointing out that in the flame arc lamps a much superior carbon was used—a fact to which Mr. Harrison himself had called attention—but that there were some types of magazine lamps in which could be used carbons of the same quality as those in the flame arc lamps, and that with these the magazine lamp gave far better results. The particular comparison, however, as to which most curiosity was excited was that between high pressure gas and electricity as regards cost. Mr. Harrison had worked it out that to maintain with gas a light at the same cost as that of an equal illuminating result with electricity as a penny per unit, the gas would have to be sold at 7d. per 1,000 cubic feet. Mr. Chattock (Chief Engineer of the Birmingham Electric Supply) did not think that gas could be sold at a profit for less than double that figure, though no doubt, as he and other speakers remarked, it might be considered worth while on the part of the gas authorities to supply gas cheap for street lighting on account of the advertisement a brilliant illumination afforded. This consideration, of course, was recognised as applying also to the supply of electricity for street lighting. Mr. Chattock did not agree with Mr. Harrison that a street lighting load was a better load for the station than a motor load, as street lighting, especially if extended to the outlying districts, would mean a considerable expenditure in special mains and services. He was not inclined to admit that street lighting was a better load, though it might be about equally good. To this, Mr. Harrison replied that whereas motors were not seen by the general public, effective street lighting might bring many fresh consumers. With regard to the data used in the comparisons between gas and electricity, Mr. Harrison explained that he had been careful to quote only those adopted by high authorities in the gas engineering side, while the gas apparatus used in his own observations was adjusted by the makers.

The Old Light and the New.

The present situation with regard to electric driving was put by Dr. Sumpner in a rather interesting way. He pointed out that until lately the practice of electrical engineers had been to use for interior lighting a lamp which gave the best illumination downwards, and for outdoor lighting one whose distribution was best in a horizontal direction at a height where the light was not wanted. The flame arc lamp, owing to the greater distance between the carbons, removed to a large extent this defect of the arc lamp from the outdoor lighting point of view, and by judicious reflecting arrangements became far superior to the old style of arc lamp lighting. It was to the tungsten lamp, however, that Dr. Sumpner, like some of the other speakers, looked to the ultimate success of electricity for street lighting. The invention of the metallic filament lamp, Dr. Sumpner remarked, had already for interior lighting removed the one obstacle to the progress of electrical illumination, namely, the cost, but Mr. Harrison had shown them how the tungsten lamp, which by the direction of its greatest illumination, was superior to the arc lamp for the purpose, could be made a most efficient means of street lighting. Other speakers expressed agreement with this, and it was pointed out that Mr. Harrison had shown the way to the solution of the difficult problem of using electricity for the lighting of side streets.

Glare versus Illumination.

Some significance was attached by other speakers to a remark by Mr. Solomon as to the increased attention which the question of globes, shades and reflectors was receiving, and as he was associated with the manufacturing side of the industry it was thought that this pointed to possible important developments in the future. With regard to the waste of light by absorption with the use of opalescent globes, Mr. Angold humorously pointed out that arc lamps in shops were often designed not so much for lighting the shops as for dazzling the customer, and an opal globe which was highly defective as a transmitter and distributor, might be most effective for this purpose. The feeling of the meeting evidently was that in the perfecting of globes and reflectors might be expected the most important advance in the near future in electric lighting. As Dr. Sumpner and others pointed out, electricity has the advantage over gas of a cleanliness which enables reflectors to be used, and to be disposed to the best advantage.

GERMANY.

("Electrical Engineer" Correspondent.)

BERLIN.

Herren Siemens & Halske have just completed the erection of the first wireless station in Siberia, between Nikolajewsk and Petropawlowsk, a distance of about 1,000 miles. The system used is the Telefunken. The energy required is about 10 kw. by day and 3 kw. by night.

New German Central Station.

As a result of the long contract made between the Elektrizitatswerk Westfalen, A.G., of Bochun, which already supplies most of the electric power to the surrounding industrial district, with the city of Barmen, the two parties are erecting at Hattingen on the Ruhr, a large station which will commence work in the autumn of 1911. It will provide rotary current of from 10,000 to 25,000 volts. The motive power will be supplied by steam turbines.

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New German Electrical Company.

A new company has been founded at Dusseldorf, called the Vereinigte Carborundum und Elektrit Werke, A.G. The object is the preparation in the electric furnace of carborundum and other products used for grinding and polishing and for electric insulation. The capital is in round numbers £100,000 in English money, of which about £16,000 will go to buy the already existing factory of the same products as Benadek. All the shares which are £8 each are taken over at par for disposal by the Imperial Austrian Landerbank of Vienna.

Electric Sterilisation of Water.

The ozone apparatus, cheap and efficient as it is, seems to be doomed to yield to the Cooper Hewitt lamp as a means of sterilising water. The ultra violet rays emitted by the mercury lamp appear to be more potent germicides than ozone and have the advantage that they need not be brought into direct contact with the water. Some very favourable results have been reported from Marseilles with reference to the mercury lamp, but it has in its turn a powerful rival, perhaps a superior, in an ordinary Geissler tube (made of quartz which causes less ray loss than glass) containing hydrogen at the pressure of one ten thousandth of a millimetre pressure. This is enclosed in a wider glass tube and the water passes through the space between the tubes. A current of 12 watts (two amperes and six volts) is passed to the Ruhmkorff exciting the Geissler tube. The length of the Ruhmkorff spark is 15 mm. Water containing 29,000 bacilli per c.c. was fully sterilised by this small apparatus at a rate of 5 litres per minute. The electric energy required per c.metre sterilised is 0·04 kw. hours. This result is quite equal despite the small scale on which the apparatus is worked, to that obtained with the Cooper Hewitt lamp working with much larger quantities of water. Nevertheless, a German writer in the Elektrotechnik und Maschinen points how still more favourable results could be obtained with the Geissler tube process. He calls attention to errors of measurement which exaggerate the current used, which he estimates to be nearer 00·1 than 0.04 kw. He also shows that the Geissler tube gives more ultra violet rays than the mercury lamp with the same cost for energy, and, therefore, increased purifying power. The Geissler tube gives practically ultra violet rays only, while the mercury lamp wastes much of the electric energy by producing from it light and heat beams, which have, of course, no sterilising power.

Electricity in Warehouses.

It was formerly common in Germany for big firms to have their own generating plant, but the increased value of floor space and the cheapening of the unit supplied by the electrical works has resulted in several plants being sold or scrapped. The private plant has to be on the spot, where ground rents are high, while the bought supply can be had from a distance far away from expensive sites.

Fungoid Growth in Rubber Insulators.

The attention of electricians in Germany is being called to the destruction of rubber insulators by fungoid growths, even when enclosed in pipes of enamelled iron. The special fungus concerned is Asgurgillus glaucus. Any rust of ironing wires promotes the growth of the fungus which accelerates the breakdown of the insulation. Of course, the formation of rust and the growth of the fungus are impossible except in the presence of moisture. Therefore, the remedy is to see that all iron-wire is quite bright when put in the tube, and to ensure the dryness of the tube interior by blowing hot air through it. The future access of damp must be prevented. Herr Simon, writing in the "E. T. Zeitschrift," suggests disinfecting the tube with a strong solution of carbolic acid, but there are several drawbacks to this procedure. The phenol will probably escape before the water with which it is mixed has disappeared, and the resistance of india-rubber to the prolonged action of the acid is at least doubtful. If circumstances make it impossible to keep the inside of the tube dry a first-class red lead paint is the best preservative against both damp and fungi.

Company Notices.

The Siemens Schuckert Werke, G.m.b.H., Berlin, made a net profit of 10,602,481 marks for 1909–10, and pays 10% dividend on its capital of 10 million marks. The net profit for 1908–9 was 10,267,876, and the dividend the same. The carry-over for 1910–11 is 252,481 (67,876) marks.

The Siemens & Halske, A.G., Berlin, pays 12% for 1909–10 on the capital of 63 million marks. The net profit for the year was 11,504,258 marks, as against 11,429,009 for 1908–9. The carry-over is increased from 1,037,014 to 1,060,551 marks.

The Elektrizitats, A.G. vorm Schuckert & Company, of Nurnberg, made a net profit of 5,208,119 (4,535,953) marks for 1909–10. Of this, 300,000 marks will be applied to start a reserve fund, an asset which the company has not hitherto possessed, while a dividend of 7% will be paid and a sum of 1,238,573 marks will be carried over.

At the general meeting of the Berliner Elektrizitatswerke, a shareholder complained of the low price of the shares on the market. The general director, Dr. Rathenau, replied that it was due to the fears of many shareholders that the Berlin municipality would acquire the concern in 1915, but at the same time pointed out that there was no ground for any apprehension, inasmuch as the company had invested one-third of its capital in the Elektrizitatslieferungsgesellschaft. The meeting which represented 29 million marks of capital, approved a dividend of 4½% on the preference and 11% on the ordinary shares. It was reported that the amount of current sold during the third quarter of 1910, was 8,282,230 kw. hours, an increase of 17% on the corresponding amount for 1909.

UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The great developments in electric lighting methods which have been made during the past few years are leading towards the evolution of a new type of illuminating engineer. The lighting expert of the past no longer satisfies modern needs. The illuminating engineer of to-day has to carry in his wallet some at least of the distinctive qualities of the artist and the architect, the chemist and the ophthalmologist, and to possess some sympathetic knowledge of the psychological as well as the physiological aspects of lighting. To meet these new needs the series of thirty-six lectures recently given at the Johns Hopkins University at Baltimore should prove of inestimable value, and their publication in book form is an event of some importance on both sides of the Atlantic. The thirty-six lectures were delivered by twenty-four different lecturers, each of whom is a specialist on the particular aspect of the subject dealt with, and the combination into one volume of all the addresses may be regarded for the time being as the last word of the scientists upon this especial branch of electrical development. In a recent paper read by Mr. W. J. Serrill, it was pointed out that the practice of illumination is not only an art, but a profession. "Those arts," he said, "in which the processes are so simple that no knowledge of the underlying principles is needed in order to practice them are arts pure and simple; in proportion as the processes become complex and involved, and as the problems contain many variable quantities, a knowledge of these principles becomes essential, and the art merges into a profession. The more complex the problems involved in illumination, the more numerous the practical obstacles, the more essential becomes a knowledge of, and a constant reference to, the principles which underlie the profession of illuminating engineering." Mr. Serrill urged that the whole subject was fraught with grave consequences to the future of the race. "Concerning the most vital one of those five senses which form the connecting links between the personality of the individual and the physical world, it is destined to exercise an important influence on the progress of civilisation. It enlists the services of the physicist, the chemist, the mathematician, the physiologist, the oculist, the manufacturer, the architect, the artist, and in this list the commercial man holds an honourable and commanding position. No one, two or three of the types of men here named can solve the multifarious pro-

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blems of the profession. It requires the services and the co-operation of them all. The profession cannot afford to have any one of them hold aloof, and it will prosper in proportion to the degree of co-operation and of interchange of opinion that is maintained and to the extent to which those individuals who compose each group endeavour to broaden their views by obtaining as great a knowledge as possible of the activities of the other groups. The commercial man cannot afford to remain ignorant of the progress of illuminating engineering. The best basis upon which to build the knowledge and experience of salesmanship in this commodity is a familiarity with the principles of illuminating engineering."

Colour Photometry.

Apart from these lectures, the science of illumination is already gathering round it quite a respectable quantity of literature of its own. Detailed publication, for instance, is now being made of the papers read at the recent Convention at Baltimore of the Illuminating Engineering Society, and some of these possess a value for the engineer which it would be difficult to over-estimate. In one of these papers Mr. Herbert Ives drew some important conclusions from a comparison of spectral luminosity curves obtained by the flicker and by the equality-of-brightness methods. While demonstrating that of the several methods of colour photometry these alone possess sufficient sensibility to warrant their use. Mr. Ives pointed out that experiment has shown the criteria of these two methods to be different. The effect of the illumination, size of field, and differences in colour vision of the observers were investigated, and it was found that the sensibility of the flicker method is greater under all conditions, but especially at high illuminations and in the middle of the spectrum. When the illumination is decreased the luminosity curve is shifted toward the blue end of the spectrum with the equality-of-brightness method, whereas with the flicker method the shift is in the opposite direction. The effect of changing the size of the field of view is also different with the two methods. In the equality-of-brightness method, decreasing the size of field increases the sensitiveness at the red end, but with the flicker method it decreases it. The most important fact shown by Mr. Ives's investigation is probably that the flicker method and the equality-of-brightness method give more nearly the same values at high than at low illuminations. At the highest illumination used the mean of numerous flicker and equality-of-brightness curves would very nearly if not exactly coincide, and this is an argument for choosing such an illumination as the standard one for making heterochromatic comparisons. Mr. Ives urged that deciding upon a method, standardising laboratories should issue standards of different colours, but in the ordinary testing laboratory it should be unnecessary to compare sources of different colours.

Photometric Flame Standards.

At the same meeting Dr. E. B. Rosa and Professor Crittenden presented a paper describing the work done at the Bureau of Standards to determine the adaptability of Hefner and pentane lamps for primary standards. In the course of the paper it was shown that the common specifications for these lamps do not give as great uniformity as is desirable, and it appears that variations between different Hefner lamps have been traced to an absence of uniformity in the wick tubes, the thickness and conductivity of which have been found to vary considerably in apparently identical lamps. Dr. Rosa and Mr. Crittenden favour the Krüss form as being less fatiguing to the eye, and also as permitting more consistent settings and a higher degree of reproducibility. The variation of candle-power with humidity, they state, has been determined and the value of this co-efficient found to agree with the work of Liebenthal, being 0·56% per litre of water vapour per cubic metre of dry air. With weather conditions actually encountered this correction has a range of about 13%. It is shown that with a flame height of 45 millimeters the Hefner lamp would give very closely one international candle. Even greater differences have been found in different makes of pentane lamps, and it was also found that the material on the market sold as pure pentane was not sufficiently uniform for the purpose. The pentane lamp when first lighted increases in candle-power up to a maximum, and then decreases to a steady value, the time for arriving at which varies with different lamps and ranges from 15 to 30 min. The humidity correction for the pentane lamp has been found the same as for the Hefner lamp, and it is believed that this will apply to all forms of flame lamp. This is in disagreement with the value determined by Patterson at the National Physical Laboratory, and it is believed that the latter is incorrect. His value is 0·66%. The differences between different 10-c.p. pentane lamps amounted to as much as 0·25 c.p. As to reproducibility, a given pentane lamp is more accurately reproducible than a Hefner lamp when both are operated under correct conditions, but there is a greater difference among pentane lamps than among different Hefner lamps. For this reason the authors consider that the pentane lamp with suitable specifications would be preferable as a standard, but the present specifications are inadequate. It is to be preferred to the Hefner also on account of the colour of the flame. It is not considered necessary to consider the effect of carbon dioxide upon the candle-power if proper ventilation is arranged for. The authors prefer continuous ventilation and the exclusion of the products of combustion from the room. While the electric incandescent lamp is to be preferred as a working or secondary standard, and for maintaining a primary standard the flame lamps are considered valuable for checking this standard from time to time by entirely independent means. With a particular lamp, results are reproducible to a few parts in one thousand, and with proper specifications the unit would be reproducible with about the same order of accuracy. Mr. Crittenden adds that the Carcil lamp has been tried and found to have a mean candle-power of 9·6, but as the variations were found to be as large as 5% it was not deemed worthy of consideration as a flame standard.

Resistance Changes of Silenium.

At the last meeting at Chicago University of the American Physical Society, Professor F. C. Brown, of the University of Iowa, summarised the results of his recent experiments with light-negative silenium and suggested an explanation of the remarkable resistance changes of this material which are the reverse of those usually noted with high-sensibility silenium. The sensibility of light-positive silenium, said Mr. Brown, is a function of its resistance. A certain specimen having a resistivity of 1,000,000,000 ohms charged its resistance in the ratio of 300 to 1 when exposed to intense illumination, while a Giltay cell having a resistivity of 500,000 ohms showed a sensibility of 30 to 1. But the light-negative silenium has a resistivity of only about 100 ohms and displays its resistance changes in the opposite direction. Mr. Brown also showed that its resistance changes due to temperature and moisture are the reverse of those met in high-sensibility silenium. The light-negative silenium is very unstable, a slight jar or quick temperature change causing it to go into another light-positive form; but when put away in the dark for two months one specimen returned to its original condition. The speaker offered, as a hypothesis for the light action of silenium, the explanation that the element as prepared for photo-sensitive cells is made up of three kinds of allotropic modifications *A*, *B* and *C*, one of which is a small or zero conductivity, and the other two of lower resistivity, the three forms passing back and forth into each other with changes of light intensity. At the same meeting Mr. Gordon Fulcher showed that the "canal" rays of the vacuum tube produce light by molecular collision, the molecule struck setting up the ether vibrations and the light intensity produced being proportional to the number of collisions; though no light is developed at all unless sufficient energy is present to cause ionisation. Professor Millikan presented a paper on the increase in positive potentials of metals exposed to ultra-violet light, and showed that the photo-electric potential produced is proportional to light intensity.

Electric Railway Company's Rights.

With the famous Peoria electrolysis judgment still in the memory a decision of the Appeal Court of Indiana, of which the text has just been published, acquires special interest, since it expressly supports and upholds the right of an electric railway company to operate a single-phase,

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high-tension alternating current system even though there is demonstrable interference with the proper working of telegraph and telephone wires in the vicinity. In this case the Chicago, Lake Shore and South Bend Railway Company operate a single phase electric railway between Chicago and South Bend with a trolley voltage of 6,600, and the Lake Shore and Michigan Southern Railway Company, the Postal Telegraph Cable Company and the Western Union Telegraph Company jointly sought an injunction to restrain the Chicago Lake Shore and South Bend Company from operating the line by this means on the ground that their signal wires and telegraph wires were disturbed by excessive induction effect. The local Superior Court refused the injunction and that refusal has now been upheld by the Appeal Court. The essence of the judgment is contained in the following extract: "In the absence of any charge or showing of negligence, unskilfulness or malice on the part of the defendant, an inter-urban railroad cannot be enjoined from using in the operation of its cars on the right-of-way belonging to it an electric system known as the single-phase, alternating-current sytsem and the high-tension current of electricity required to operate cars thereby, even though the use thereof may greatly interfere with the maintenance and use by plaintiff of its electric telegraph lines and signals necessary in the operation of plaintiff's railroad on its property adjoining the defendant's right-of-way. The use of the single-phase alternating current of electricity to effect a lawful purpose on one's own premises does not constitute a nuisance even though the electricity may escape and interfere with the operation of electrical devices on adjoining property. In the absence of negligence any damage caused thereby is *damnum obsque injuria*." There is, it appears, some talk of taking the case to the Supreme Court.

The Resistivity of Copper.

The temperature-coefficient of restivity in copper forms the subject of a valuable paper by Mr. J. H. Dellinger, which has just been published in a bulletin of the Bureau of Standards. A number of samples of copper, drawn by the Bureau from various manufacturers and tested for resistivity, and it was found that between the limits of variation prescribed in practice for resistivity, the temperature-coefficient varied directly as the conductivity. The Bureau, says Mr Dellinger, selected a meter-gram of soft copper at 20 deg. C. as having 0·153022 international ohm. This quality of copper has a temperature-coefficient of 0·00394 at 20 deg. C., or an absolute temperature of $-10/00394. = -253·8 + 20 = -233·8$ deg. C. The temperature-coefficient at 0 deg. C. is thus $1/233·8 = 0·004277$. If now some other sample of wire, hard drawn or otherwise slightly imperfect, has 2% greater resistivity than this standard, its absolute temperature below zero will be 2% greater than —233·8, or —238·5. Or, if the conductivity of the new sample is 2% less than the normal, the temperature-coefficient will be 2% less than 0·00394 at 20 deg. C. The final conclusion is, therefore, that between the conductivity range of 97 and 102% there is only one essential electrical definition of copper—either the resistivity or its temperature-coefficient, since if one is known the other may be readily deduced. Commenting on Mr. Dellinger's paper, the "Electrical World" observes that "the temperature-co-efficient adopted by the American Institute of Electrical Engineers is 0·0042 from and at 0 deg. C., corresponding to an inferred absolute resistivity zero temperature of —238·1 deg. C. That adopted by the Institution of Electrical Engineers in England is 0·00428, or —233·6 deg. C. The value taken by the Verband Deutscher Elektrotechniker is 0·00426 or —234·7 deg. C., and that generally used in France is 0·004, or —250 deg. C. Excepting the last named, it would appear that the values obtained lie close together, and that there should be little difficulty in reaching an international agreement. It is to be hoped that this matter may be brought to the attention of the International Electrotechnical Commission for an early discussion."

Electricity in Water Filtration.

A novel application of electric drive in connection with water filtration plant is described in the current week's technical press. The cleaning of the filter-sand is accomplished by means of an inverted open box, sunk under water to the sand-surface and suspended from rails so arranged that the box can traverse the whole area of the filter-bed. The box contains a revolving hollow axle terminating in a hollow head from which fingers or stirrers extend down into the sand, and as the axle and head revolve, clean water under pressure is forced through and passes into the sand through small holes in the fingers. A suction pump draws off the dirty water, taking away just a little more than is supplied by the pressure pump, and in this way all the dirt which has been stirred and washed from the sand is discharged into a sewer. While the operation is proceeding the whole machine moves slowly ahead over the sand. The filtration machine now in use at Wilmington, Delaware, is operated electrically by means of a double overhead trolley, and energy is conveyed by means of six 220 volt d.c. motors. These are employed as follows: Side-travel, 7·5 h.p.; hoist for lifting and lowering box, 7·5 h.p.; stirrer-wheel spindles, 20 h.p.; crane travel, 20 h.p.; discharge pump, 10 h.p.; pressure pump, 25 h.p. All of these are variable-speed reversible machines, except the discharge-pump motor and the motor for the spindles. A switchboard provided with a controller for each motor is mounted on the machine at the operator's position. The main switch is designed to carry 300 amp at 220 volts and is provided with no-load and overload release. The motors installed are purposely of large size to prevent heating in the confined locations in which they are placed. The total amount of energy required to operate the machine under normal conditions is from 20 h.p. to 45 h.p. The longitudinal speed of travel of the machine is from 2 ft. to 12 ft. a minute and the filter-sand may be stirred up to a depth of 24 in. The amount of wash water required is from 120,000 gallons to 180,000 gallons per acre of filtration bed.

REVIEWS.

"All About Railways." By F. S. Hartnell (374 pp., with 48 illustrations). London: Cassell & Company, Ltd. 6s.

There are few subjects more fascinating, either from the engineer's or from the layman's point of view, than the evolution of modern railway systems. Mr. Hartnell calls his portly and well-illustrated volume "A Book for Boys," but it is quite worthy to take rank with any of those romances of great industries which appeal to "children of a larger growth," and make much more ambitious claims upon public attention. That it is free from cumbersome technicalities and tells the railway story from the days of Hedley's "Puffing Billy" and Stephenson's "Rocket" to those of the latest developments in electric traction in plain, simple, but by no means unpicturesque language, is all in its favour, even from the engineer's point of view; while for the technical student it provides a comprehensive picture of the rise and growth of traction which cannot fail to prove helpful and inspiring. After dealing in a very happy fashion with the early history of railways, the writer describes in lucid terms the working and the building of a locomotive, deals with the various types of engines which have been evolved to meet the demands of high speed or heavy tractive effort in this country, in the United States and Canada, and with the development of the passenger coach from the old cattle truck type to the modern Pullman and the luxurious suites of cars constructed for the use of Royalty. A chapter on signalling embraces the history of train dispatching and control from the single line baton, or staff system, up to the automatic electric system of to-day. There are sections dealing with the permanent way, with brakes, and with accidents; with light railways and feeder lines; with famous trains, and with such triumphs of engineering as the Trans-Andean Railway, the great loops on the Canadian-Pacific, the New South Wales "zig-zag," the St. Clair tunnel of the Grand Trunk Railway of Canada, and many others; while a special chapter is devoted to famous bridges and their construction. The story, indeed, is carried through every phase of construction and development up to the latest type of the Brennan Mono-rail; and from cover to cover there is not a dull page in the book. The value of the volume is greatly enhanced by the extremely well-selected illustrations.

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

BACUP.—The Rawtenstall Town Council recently approved of a draft agreement for selling electricity in bulk to the Bacup Corporation. The latter authority has already obtained the sanction of the Local Government Board for the borrowing of £3,000 for mains, meters, etc., required for the distribution of the current, and the work of laying the former and the fitting of a transformer station is to be proceeded with without delay.

BALLYCLARE.—The new electricity generating station is equipped with natural gas suction plant and natural gas engine, a Witton 25 kw. dynamo, and all other fittings, and includes a 127-cell "Premier" type storage battery, with a capacity of 360 ampere hours. Public lighting is provided for by the erection of 69 lamps, mostly of 50 c.p., but a few of 100 c.p.

BECKENHAM.—The Council have agreed that the price per lamp per annum to be paid to the Electricity Committee be the sum of £3 7s. 6d., the price at present paid to the Gas Company, less a reduction in respect of this Committee, providing the services and fittings hereunder mentioned, such reduction to be the equivalent of a sinking fund payment on the proposed expenditure calculated at $3\frac{3}{4}\%$ on a 15 years' basis. The Electricity Committee to arrange with the Gas Company as to the lighting of a few lamps which cannot at present be reached by the existing electricity cables. This Committee to defray the cost of the necessary services, cables, lamps and fittings, estimated at £350, out of the district fund, and if the district fund is insufficient to meet the expenditure necessary, additional sum to be provided for in the next general district rate. It is proposed to use 70 c.p. lamps and the profit to the Department is estimated at £74, but probably a few 100 c.p. lamps will be used for exceptional positions, and this will pull down the profit.

BOGNOR.—The proposal that the Town Council should apply for a Provisional Order under the Lighting Acts has been lost by seven votes to two.

DORCHESTER.—At the monthly meeting of the Dorchester Town Council, the General Purposes Committee reported they had had a consultation with Mr. Steele, representing Messrs. J. and W. Purves, of Exeter, who outlined the scheme proposed by his firm with reference to their application for a Provisional Order for the supply of electricity for the borough. The Committee recognised the great desirability of having the town lighted by electricity, and recommended that no opposition be made to the obtaining of the Order by Messrs. Purves, as explained by their representative. The Council unanimously adopted the Committee's recommendation.

DYSART.—The Dysart Town Council have given their consent to the Fife Tramway Light and Power Company, Ltd., applying for a Provisional Order for the generation and distribution of electricity for lighting purpose within an area to include this town. It is proposed to lay mains in five of the principal streets.

EDINBURGH.—The Electric Lighting Committee of Edinburgh Town Council have resolved to recommend that application be made to the Secretary for Scotland for consent to borrow the sum of £75,000 in connection with the condensing towers and machinery installations.

ERITH.—The Local Government Board held an inquiry into an application for permission to raise a loan of £10,000 for electricity works extension. The £10,000 was made up as follows:—1,000 kw. turbo alternator, fixing plant, boiler, etc., £7,000; mains, £450; meters, £900; house services, £550; transformer and sub-stations, £800; motors for hire, £300. Of the £7,000, £1,918 was for a Robeson-Bettengton boiler and rotors; £4,810 10s. for a 1,000 kw. impulse turboalternator, etc.; £125 4s. for pipes and contingencies, and another specification of £146 6s. The inspector asked many questions as regards the boiler, and finally suggested that the loan should be made for 10 years, in place of the usual 15 years.

FROME.—The Board of Trade are asking for further particulars as regards the proposed transfer of the electric lighting undertaking from the Council to Messrs. Edmundson, the contractors.

LEITH.—The Town Council are reducing the charges made for supplying electric energy for lighting purposes, and for power and heating purposes, to $2\frac{3}{4}$d. per unit and $1\frac{1}{2}$d. per unit respectively, the reduction to take effect at the beginning of next year.

LEYTON.—A Local Government Board inquiry has been held into the application for powers to borrow £7,000. This sum is required for a mixed pressure turbine, with both a lighting and a traction dynamo attached, with a capacity of 600 kw. It is estimated that the saving in coal alone will be about £783, less interest on loan.

LONDON, ISLINGTON.—The London County Council forwarded an Order under seal sanctioning the borrowing by the Islington Council of £19,365, for purposes in connection with the electricity undertaking, and intimating that if it was desired to take up the loan from the London County Council, the rate of interest at present charged on loans to local authorities was £3 15s. per cent. per annum, irrespective of the amount and period of the loan.

MARKINCH.—The Council have approved the proposal of the Fife Tramway, Light and Power Company, Ltd., to apply for a Provisional Order under the Electric Lighting Acts, and to take in the borough.

NUNEATON.—The Corporation are purchasing 2,500 square yards of land adjoining the electricity works at a cost of £500.

OLDHAM.—The question of applying for permission to raise a loan for electricity extensions is to be taken into consideration. Mr. Newington, the Corporation electrical engineer, will probably bring forward a scheme for electrical lighting of cottages and tenements at a stated sum per light per annum. The Board of Trade have refused the Council's application for a combined Provisional Order for the lighting of Chadderton, Royton and Limehurst.

PLYMPTON.—A decision of the Council to refuse permission to Messrs. Heath & Company, the electric contractors, to lay mains in the street, was rescinded.

SOUTHAMPTON.—The Borough Council are about to spend £2,700 on extensions of mains. This includes extensions from the Western Shore works to Shirley and to Stag Gates.

SUNDERLAND.—The following alterations in the scale of charges are to be introduced by the Council: "Domestic" rate to private houses, for lighting, and to include electricity used for heating and cooking. A fixed quarterly payment plus $\frac{3}{4}$d. per unit. In the case of a house with a nett rateable value of £30, the fixed charge will be £3 per annum. The charge to offices and banks to be reduced to long hour consumers. A new tariff for shops, warehouses, theatres, halls, etc., lighted throughout by electricity, the scale commencing at $2\frac{7}{8}$d. per unit, and falling to $2\frac{3}{4}$d. and $2\frac{1}{2}$d. for increased consumptions, while to still larger consumers under special agreement further reductions are recommended. To licensed premises and others having equivalent lighting hours, and electrically lighted throughout, $1\frac{3}{4}$d. per unit. Heating and cooking. To any premises using electric light, $\frac{3}{4}$d. per unit. Ordinary low tension power supplies £3 per kw. per annum, plus $\frac{1}{2}$d. per unit.

UPHOLLAND.—The Bispham Hall Colliery Company, Ltd., having recently laid down an additional large generator have a greater electric output capacity than needed, and so have offered to supply the District Council. The proposal is being considered.

WATFORD.—At the last Council meeting the electrical engineer reported that for the four weeks ending November 1, the coal cost averaged ·362 pence per unit sent out as compared with the bonus figure of ·4 pence per unit, and that the bonus for the month amounted to 16s. for each shift engineer, 12s. each stoker, and 6s. each driver.

WEST ASHFIELD.—The Rural District Council has been asked to approve of the Provisional Order under the Electric Lighting Acts, which is being applied for by the East Kent Electricity Supply Company, Ltd.

WEST PELTON.—Messrs. J. Joicey & Company (Ltd.), are at present installing electric plant into the Twizell Colliery, and the erection of two large engine-houses is in contemplation.

OVERSEAS.

BERNE.—The Swiss Federal Telegraph and Telephone Administration will purchase of material and tools for construction and extension of lines, 4,166,000 frs.; telegraph and telephone apparatus, 1,129,000 frs. during the coming year.

MELBOURNE.—The City Council have decided to provide an accumulator plant in order to meet the increased demands anticipated during the winter season of 1912. It was estimated that a 1-4000 ampere hour accumulator battery, with switches, connections, booster, etc., would cost £21,000. The necessary buildings would involve the expenditure of £5,000; pilot cables, etc., would cost £540, and cable alterations £3,000, making the total outlay £29,540.

MEXICO.—A twenty years' concession has been granted to Senhor José L. Regnena for the utilisation of water from the River Cuautitlan, in the State of Mexico, for hydro-electric purposes. Work must be begun within 24 months, and completed within 7 years. The concessionaire may set up telegraph and telephone lines, and may build bridges for his private needs. All the machinery and apparatus required for the work may be imported, once only, free of duty.

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PERTH.—Tenders will be received at the office of the Deputy Postmaster-General, Perth, Western Australia. up to noon on April 18, 1911, for the supply of a common battery switchboard and accessories. (Schedule No. 85). A deposit will be required with each tender. Local representation is necessary. For copies of the specification and form of tender application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid.

URUGUAY.—Laws have been passed granting (1) to Messrs. Silveira Hermanos a 25 years' concession for providing the town of Melo with electric light, and (2) to Messrs. Carbonell & Company a 20 years' concession for providing the town of Trinidad (Uruguay) with electric light.

TRACTION.

HOME.

DUNDEE.—It has been decided to extend the municipal tramways. The extension of the Blackness system, 1,200 yards is estimated to cost £4,550 and £1,250 per annum for upkeep. The Lochee route, a distance of 700 yards, will cost £2,640 to instal and £827 a year for upkeep.

EDINBURGH.—The Board of Trade have passed the Slateford tramway line.

GLASGOW.—The Board of Trade has passed the extension of tramway to Ranken Glen from Barrhead. This links up the Glasgow with the Paisley system.

GLOSSOP.—A proposal is on foot to run a mono-rail tramway from here to Marple Bridge. It will be altogether 5½ miles in length, and powers will be sought for the carriage of goods and minerals as well as passengers.

LONDON.—It has been agreed that the old Works Department of the L.C.C. in Belvedere-road are to be transferred to the Council Tramway Department, as the new headquarters, at a sum of £76,000, to be charged against the Department.

NORTHAMPTON.—The Town Council have purchased some cottages at the back of the Electric Power Station in readiness for extensions, which will be necessary when the tramway system to Far Cotton is in operation.

OVERSEAS.

OTTAWA.—The following applications are to be made to the Parliament of Canada :—1. For the incorporation of the Canadian Northern Branch Lines Company, with power to construct a number of lines of railway, and to use electrical and other energy. 2. For permission for the Buffalo, Niagara and Toronto Railway Company to construct a branch line from Niagara-on-the-Lake to St. Catharines, and to use motive power other than steam.

ROSARIO.—The Rosario Electric Tramway Company has forwarded to the Municipality a petition asking for an extension in their concession for 25 years, up to September 15, 1985. In return they offer to construct 30 kilometres of new line in accordance with plans of the Municipality and to increase the line by 10 kilometres for every increase of $1,000,000 in the receipts. This increase of 10 kilometres would cease 20 years before the expiring of the concession. They also offer to reduce the fare to a uniform one of 10 cents, to construct a double line in the Avenida Central, to hand over to the Municipality 1,250,000 francs for the building purposes, and to forego the lawsuit they intended to bring against the Corporation for not having been allowed to construct the line in Avenida Belgrano. According to the directors' report the company works at a loss of $77,676 a year.

WELLAND, ONTARIO.—Final steps towards the construction of a million dollar electric railway between Niagara Falls, Welland and Dunnville are now being taken. The officers and directors of the road, the Niagara Falls, Dunnville and Welland Electric Railway, at a meeting in Welland decided to go ahead with the construction. A provincial charter has been secured, and franchises from towns and cities and townships through which the road will pass will now be asked for. The head office of the company, its car barns and machine shop and a large station will be erected at Welland, at a cost of $12,000. A $20,000 station and restaurant will be erected at Niagara Falls. A station at Dunnville will be erected at a cost of $3,000. It is proposed to extend the line to Port Dover later on.

COMPANIES' MEETINGS AND REPORTS.

MANX ELECTRIC RAILWAY.

Mr. G. A. Boscawen presided in London at the eighth annual meeting of the Isle of Man Electric Railway Company. He stated that 533,104 passengers had been carried during the past year. The receipts were £165 lower, but the expenditure was £801 higher than in the previous year. This was accounted for by the fact that, in the absence of a tenant for Laxey Glen Gardens and Hotels, the company had had to run that concern themselves, with a consequent loss of £702 in rent, and an expenditure of £622 on bands, etc. The gardens and hotels had been let. The report was adopted.

BRITISH COLUMBIA ELECTRIC.

Mr. R. M. Horne-Payne presided at the annual general meeting of the British Columbia Electric Railway. Once again, he said, they presented a report containing accounts of satisfactory progress, expansion of business, and of good prospects. They seemed now to have reached a period of more gradual development. Nothing could be more satisfactory than the development which had taken place and was taking place. It was true that this had involved large capital expenditure, and would involve he hoped, large, although less rapid, capital expenditure for some years. Referring to the new line from Westminster to Chilliwack, he said that the management reported that almost from the outset they would be able to earn 5 per cent. on the £400,000 the line and its equipment had cost. This money had been earning nothing during construction, and this was also the case with large sums spent on the construction of other extensions in the neighbourhood of Vancouver and New Westminster and on the hydro-electric power installations near Victoria and Vancouver. The major portion of these works had either been recently completed or would be completed during the next three months, and would increase their revenue in the future. Shareholders must not think from what he had said that the new lines were suddenly going to earn profits at the same rate that the old ones had done in the past. The earning power of the new lines must naturally be much lower for some years to come, and they would necessarily increase the expense ratio of the whole system; but if they earned only the barest interest on their cost at present the shareholders should be well satisfied, as they were beyond all question building up a splendid business. He moved the adoption of the report, which was carried.

A resolution increasing the capital to £3,200,000 by the creation of 700,000 new shares of £1 each was agreed to.

COMPANIES REGISTERED.

CRYSTAL PALACE KEARNEY HIGH-SPEED RAILWAY SYNDICATE.—Capital, £30,000, in £1 shares. Objects: To deal with a railway, tramway, rolling-stock, approaches, stations, surroundings, locomotives, cars, carriages or other vehicles, and all accessories and appurtenances, wholly or partly in accordance with the Kearney high-speed system, or otherwise, in the grounds of the Crystal Palace or otherwise, and to adopt an agreement with E. W. C. Kearney. Minimum cash subscription, seven shares. The directors to number not less than two nor more than five. E. W. C. Kearney is the first. Qualification, 100 shares. Remuneration, £100 each per annum (chairman, £120). Registered office, 100, Victoria-street, S.W.

MONTREAL TRAMWAYS AND POWER COMPANY, LIMITED.—Capital, £4,110,000 (200,020 shares of £20 10s. 11d. and one of £422 8s. 4d.). The objects are stated to be to construct, purchase, lease, or otherwise acquire tramways and street railways in Canada or any province thereof, or to acquire the shares, bonds, debentures, or other securities of any company owning or controlling the same; to equip and maintain the same by electricity, steam, horse, or other mechanical power; to carry on the business of tramway, railway, automobile, omnibus, and van proprietors, carriers of passengers and goods, manufacturers of and dealers in carriages, trucks, locomotives, motors, accumulators, dynamos, and the like; to enter into any contracts with other companies or persons as to interchange of traffic-running powers or otherwise; to supply electricity for light, heat, power, or other purposes, and to adopt an agreement with the Imperial Trust Company, of Montreal. Registered office: 4, St. Mary-axe, E.C. The file number is 113,139.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 150, Fleet Street, London, E.C.

CONTRACTS.

GATESHEAD UNION.

The Guardians of the Poor of the Gateshead Union propose erecting a LIGHTING INSTALLATION in connection with their new buildings at the Whinney House Estate, Shotley Bridge. The installation will include 2 high-speed Engines and Generators, Storage Battery, Switchboard, Wiring Installation, for about 500 lights, and other accessories. Firms desirous of tendering are requested to send in their names to the undersigned, accompanied by a deposit of £5, which will be returned on receipt of a bona-fide tender before Wednesday, the 21st instant. Specifications will be issued by the Consulting Engineers, Messrs. Tennant & Barrs, Cathedral-buildings, Dean-street, Newcastle-upon-Tyne, on December 30, 1910, from whom any information can be obtained, and at whose offices plans of the buildings may be inspected. Tenders are to be delivered to the undersigned on or before 9.30 a.m. on January 9, 1911. No portion of the contract will be let separately, and tenders for the complete equipment only will be considered. The lowest or any tender will not necessarily be accepted.

By order,
GEORGE CRAIGHILL,
Union Clerk.

Poor Law Union Offices,
Prince Consort-road, Gateshead-on-Tyne.
December 16, 1910.

CONTRACTS OPEN.

HOME.

BURY.—Borough Council. Section A, steel steam pipes, valves, and accessories; section B, cast-iron pipes, valves, and accessories. Specifications, £1 1s. Particulars, see Engines. January 4.

EAST HAM.—Corporation invite tenders for one 1,000 kw. triple-expansion medium-speed engine and generator complete; one evaporative condenser, with air and circulating pumps, piping, valves, etc. Specifications, etc., obtained (deposit £2 2s.), Mr. W. C. Ullmann, Tramway Depot, Nelson-street, East Ham. December 30.

ISLINGTON.—Borough Council invite tenders for the supply and erection of a high tension switchboard at Eden-grove generating station. Specification, etc., from Chief Electrical Engineer, 50, Eden-grove, Holloway. January 12.

LEYTON.—Urban Council invite tenders for the supply and erection of a 600 kw. mixed pressure steam turbine set with all accessories. Specification, etc., obtained (deposit £2 2s.), Mr. F. H. Lewis, Electricity Station, Cathall-road, Leytonstone. December 29.

LLANDUDNO.—Urban Council invite tenders for (a) Motor-driven induced draught plant; (b) mechanical stokers for one Lancashire and one Babcock boiler. (Particulars from Engineer, Electricity Works.) December 24.

LONDON, E.—East Ham Corporation.—Section A.—One 1,000 kw. triple-expansion medium-speed engine and generator, complete. Section B.—One evaporative condenser for 40,000 lb. of steam per hour, with air pumps, circulating pumps, piping, valves, connexions, and auxiliaries. (Particulars (£2 2s.) from Engineer and Manager, Tramway Depot, Nelson-street, East Ham.) December 30.

LONDON.—Hackney Guardians. Installation of telephones in pavilions "A" and "B" at the Infirmary, High-street, Homerton, and the removal of the existing installation in pavilion "A." Specification, Clerk, Sidney-road, Homerton, N.E. January 4.

LONDON, WANDSWORTH.—The Council invite tenders for the supply and fixing of street lamp columns, lanterns, fittings, etc., from March 31 next. Specifications from the Council House, Wandsworth. January 3.

OSRAM-LAMPS

SALFORD.—Borough Council. Air lift pumping plant. Specification, £2 2s., Borough Electrical Engineer, Electricity Works, Frederick-road, Pendleton. January 16.

SHEFFIELD.—Supply, delivery, and erection of materials for extensions to the Neepsend Power House, comprising extension of the engine room, boiler house and coal store, new pump room, turbine and boiler foundations, etc. Specification, £2 2s. General manager and engineer, Corporation Electric Supply Department, Commercial-street. December 30.

OVERSEAS.

ADRIANOPLE.—The Turkish Ministry of Public Works invite tenders for a concession for the construction and working of electric tramways in Adrianople, and for a concession for the provision of electric light in the Sandjak of Adrianople. The concessionaire will have the right to erect hydro-electric works on the banks of the rivers Maritza, Arda and Tundja. Tenders, which will be opened on March 15, should be addressed to "Monsieur le Ministre du Commerce et des Travaux Publics," Constantinople. Local representation is essential in the case of Turkish Government contracts.

CONSTANTINOPLE.—The Ministry of Public Works invite tenders for a concession for the construction and working of electric tramways in Adana, and for a concession for the distribution of electrical energy in the vilayet of Adana. The Concessionaire will have the right to erect hydro-electric works on the banks of the Upper Seïboun Tchaï River. Tenders, which will be opened on March 14, should be addressed to "Monsieur le Ministre du Commerce et des Travaux Publics," Constantinople, from whom the conditions, etc., can be obtained on payment of 9s. Local representation is necessary.

CONSTANTINOPLE.—The Ministry of Agriculture, Mines and Forests, Constantinople, for the supply for the Cozli-Kilimli Railway of:—(1) 8,550 metres of Vignoles rails weighing 20 kilogrammes per metre, with accessories for the same; (2) three locomotives of 125 h.p., with a gauge of 1·065 metre; (3) 98 coal trucks, of which 80 are to be brakeless and the rest provided with brakes. Delivery is to be made at Cozli or Kilimli not later than March 10 next. No date is mentioned to which tenders will be received. For further particulars application should be made to the above-mentioned Ministry. Local representation is necessary.

JERUSALEM.—The Municipality invite tenders for (2) electric tramways and electric lighting installations in the town; (4) telephone installation at Jerusalem, Jaffa and Bethlehem. Tenders in respect of each of the above schemes will be received by the municipal authorities up to December 31. Local representation is desirable.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, as follows:—(1) Up to 3 p.m. on February 7, 1911, for the supply of 250 ironclad indicators (Schedule No. 423); (2) Up to 3 p.m. on March 7, 1911, for the supply of a branching multiple magneto lamp signalling switchboard and accessories (Schedule No. 361). A deposit will be required on each tender. Local representation is required.

PERTH.—Tenders are invited by the Minister of Public Works of Western Australia for the supply, delivery, and erection of electrical pumping machinery (Contract No. 75). Tenders will be received by the Hon. the Minister for Works, Public Works Office, Perth, Western Australia, up to February 28, 1911. Copies of the condition of contract, etc., may be obtained, on payment of £1 1s., from the Contractor's Room, Public Works Office, Perth, Western Australia.

SYDNEY.—The Deputy Postmaster General will receive up to 2.30 p.m. on February 1, 1911, for the supply of a testing equipment, consisting of rotary convertor, transformer, switchboard, etc. (Schedule No. 59.) A deposit will be required with each tender. Local representation is necessary. Note.—For copies of the specifications and forms of tender in regard to each of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria Street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

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TAIHAPE, NEW ZEALAND.—Tenders are invited by the Taihape Borough Council for the supply and erection of a hydro-electric lighting and pumping plant. Tenders, marked "Tender for Electric Plant," will be received by the Town Clerk, Taihape, N.Z., up to 5 p.m. on January 11, 1911. A deposit of £130 must accompany each tender.

TENDERS ACCEPTED.

AYR.—Town Council. Reid & Co., wiring, £175.

BARNSLEY.—Town Council. Traction battery replating and Tudor accumulator, £555 15s.

BOLTON.—Town Council. British Insulated and Helsby Cables Co., cables.

CARLISLE.—Town Council. Cable, British Insulated & Helsby Cables, Ltd., Preston, Lancs., £545 2s. 9d.

COLWYN BAY.—District Council. Switchboard extension, B. Thomas, Manchester.

SCARBOROUGH.—Town Council. Walker & Hutton, lighting plant.

SHEERNESS.—Urban District Council. Repairs to refuse destructor, Meldrum Bros., Manchester, £137 10s.

SOUTHAMPTON.—Town Council. Messrs. Cook & Co., Council's Offices, High-street, wiring, etc., £36 12s.; R. T. Wells & Co., telephones, £13 10.

SUNDERLAND.—Town Council. Three hundred metal filament lamps, Messrs. Siemens Bros.

WHITEHAVEN.—Town Council. Wiring, etc., hospital, David Burns & Co.

OPENINGS FOR TRADE.

Plant, Wiring, Fittings, Accessories, etc.

Agreed upon.

TOWN COUNCILS.

Yarmouth: Extensions—£5,800.
Accrington: Extensions, lighting.
Leominster: Electricity works.
Southend: Extensions, tramways.

Contemplated.

Ealing: Extensions—£20,000.
East Ham: Extensions—£17,420.
Edinburgh: Extensions—£75,000.
Hammersmith: Extensions—£5,400.
Oldham: Extensions.
Newcastle-on-Tyne: Tramway's extensions, construction equipment—£78,550.
Gateshead-on-Tyne: Guardians. Complete lighting installations at Shotley Bridge.

Agreed upon.

RURAL, URBAN AND DISTRICT COUNCILS.

Bridgend: Mains, extensions.
Dorking: Mains, extensions.
Watford: Extensions, general—£4,800.
Listowel: Lighting.
Ebbw Vale: Workmen's dwellings, meters and wiring—£200.
Beckenham: Extensions—£350.

Contemplated.

Barnes: Plant—£10,000.
Ilkley: Electricity works.
Bridgwater: Traction—£1,750.
Whitworth (Lancs.): Extensions, tramways—£900.
Eastwood (Yorks.): Lighting.
Holyhead: Extensions, cable.

Constructional and other work will shortly be carried out by or for the following authorities or firms. The amount mentioned is the contract price in each case.

Manchester: Education Officer, Deansgate. Alterations and additions to Municipal School in Cavendish Road, Withington.

Mexboro': A. Brocklehurst, architect, Palatine Bank Buildings, Norfolk-street, Manchester. Chapel.

Hull: City Treasurer. Training College at Cottingham-road.

Barry Dock: Teather & Wilson, architects, Cardiff. Additions to Seamen's Institute.

Westminster: The Middlesex County Council propose shortly to pull down the existing Guildhall, facing Dean's-yard, and to erect thereon a new County Hall and Sessions House, at a cost of £72,000. The work is to be completed in 18 months.

Grimsby: W. Gilbert, Grimsby. Free Library extension.

Hartlepool: H. C. Howe, West Hartlepool. Rebuilding Golden Anchor Inn, £1,520.

Bournemouth: Jenkins & Son. Victoria Hotel, £5,180.

It is hoped that the public will not confuse the Car & General Insurance Corporation, Ltd., of 1, Queen Victoria Street, London, E.C., with the Law Car & General Insurance Corporation, which is now in liquidation. The Car & General Insurance Corporation was established in 1903, and has no connection whatever with the Law Car & General Insurance Corporation, established 1906.

NOTES.

Insulating Specialities.

Messrs. Pinchin, Johnson & Company, Ltd., the old-established varnish, colour and paint manufacturers, have long made a study of insulating varnishes and other specialities for the electrical industries. In a neat little booklet they tell us by means of letterpress and pictures something of their methods and facilities. The firm have well-equipped laboratories wherein problems of insulation are constantly under investigation. In this way not only is the standard of their regular types of varnishes and insulating materials kept up, but fresh combinations are devised to meet the needs, to overcome the difficulties of their customers. This is a point which deserves to be widely known.

Siemens Showrooms.

Dealers and contractors should note that Messrs. Siemens Brothers' Store and Showroom, at 39, Upper Thames-street, will be closed on the Monday and Tuesday, the 26th and 27th, for the holidays, and also on Friday and Saturday, the 30th and 31st, for stocktaking.

Vulcanite and Ebonite.

Messrs. H. Traun & Sons have moved from 8, Redcross-street, to 23a, Goswell-road, London, E.C.

Silvertown Rubber Abroad.

The India Rubber, Gutta Percha & Telegraph Works Company, Ltd., Silvertown, London, E., have received the following awards for their excellent display at the Railway and Land Transport Exhibition, held at Buenos Ayres:—Three Grand Prizes for brake hoses, motor tyres and cycle tyres, Gold Medal for india rubber tiling, Diploma of Honour for telegraphic apparatus.

"Multax" Long Burning Flame Lamps.

The Globe Electric Company, Ltd., have just issued Pamphlet M. 15, dealing with these lamps, which, since they were placed on the market early this year, have been sold in considerable quantities. The lamp has been adopted by several corporations and important railway companies, both at home and in the colonies. The price of carbons has now been reduced to such an extent that for given burning hours they are actually cheaper than the ordinary single carbons.

New Range of Lamps.

Messrs. Siemens Brothers Dynamo Works, Ltd., Tyssen-street, Dalston, London, N.E., advice us that they are shortly placing on the market a range of 50 c.p. "Onewatt" lamps for 100 to 130 and 200 to 250-volt circuits for street lighting only. We understand that these lamps will be of the same high quality as the other types of "Onewatt" lamps already placed upon the market by Messrs. Siemens, who are making a speciality of street lighting schemes with high efficiency drawn wire Tungsten lamps of the "Onewatt" type, as will be seen from our Contracts Closed columns.

British Telephones.

The Peel-Conner Telephone Works, Ltd., send us a copy of their No. 1 "Bulletin," which deals with their magneto call telephones. It is the first of a series they have in hand, which will cover the whole field of telephony. It will be seen on reference to the "Bulletin," which will be sent to any electrical engineer and contractor, that an innovation has been introduced, as it is not only an illustrated list of the company's standard manufactures in this line, with corresponding code numbers, code words, weights, measurements and diagrams of the various circuits, but also a comprehensive treatise on the subject of magneto call telephones, with a description and illustration of each component part. In fact, it may be considered

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INSULATING VARNISHES

Which retain their high efficiency under the most severe working conditions.

JOINTING COMPOUNDS & BOX COMPOUNDS.

MAJOR & CO., LTD.
Sculcoates,
HULL.

the first part of a complete text book on telephony which will be issued by this company. Further numbers will be issued shortly. Another publication worth having and filing is the large folder containing two pamphlets, one being the "Proceedings at the Official Inspection of the Glasgow New Central Telephone Exchange," and the other an illustrated account of the Exchange, with its equipment of Peel-Conner apparatus and General Electric Company's various appliances.

RUBBER WASHING.

An important step in emphasising London as the centre of the rubber market has been taken by the opening of a large establishment by the Crude Rubber Washing Company, Ltd., at Balham-road, Edmonton. It is a process for extraction of pure rubber from the raw material without waste, and ought to prove a factor in steadying the market. The factory is well equipped. At the Press Dinner the electric lighting equipment was admirably carried out by Messrs. A. W. Penrose & Company, Ltd.

GREATER LONDON RAILWAY SCHEME.

A Bill seeking powers for the incorporation of a new London railway company, to be called "The Greater London Railway Company," has been deposited in the Private Bill Office of the House of Commons for introduction during the ensuing Session. The proposed railway is divided in the Bill into 42 sections, of an aggregate length of 57 miles 6 furlongs 4 chains. These sections form a complete system, commencing by a junction with the London and South-Western Railway at Feltham and terminating at Tilbury by a junction with the Port of London Authority's Tilbury Docks Railway, with a branch railway to the Victoria and Albert Docks. The line from Feltham to Tilbury will form junctions with the Great Western Railway near Southall station, with the Metropolitan District Railway, with the Great Central Railway, with the London and Northern Railway and with the Metropolitan Railway at various points in the district of Wembley, with the Midland Railway at Hendon, with the Great Northern Railway at Southgate and Wood Green, with the Great Eastern Railway at Tottenham and Ilford, and with the London, Tilbury and Southend Railway at Ilford and East Ham. The share capital proposed to be raised by the company is £5,500,000, with the right to borrow a further sum of £1,833,333 by the issue of Debenture stock, which, like the share capital, may be issued as a bearer security. The time limit for construction is five years from the passing of the Act. During this period it is proposed to pay interest out of capital to an amount not exceeding £500,000. The promoters are Baron Weardale, Colonel Sir Douglas Frederick Rawdon Dawson, the Hon. Arthur Stanley, Colonel Ivor Phillipps and Mr. Harry Mallaby-Deeley, who are the first and subsequent directors of the company. Provision is made in the Bill to empower the companies with whose systems junctions are formed to subscribe each a sum of £250,000 towards the capital of the company. Power is also sought to enter into working and traffic arrangements with them.

C. PASS & SON, Ltd.
Bedminster Smelting Works, BRISTOL.
SELLERS OF
ANTIMONIAL LEAD OF ALL GRADES.
BUYERS OF
LEAD ASHES & LEAD RESIDUES FROM ACCUMULATORS.
Telegrams: "PASS, BRISTOL." Telephone: 475.

Ladders, Steps, Trestles. Scaffolds, &c.
Sale or Hire.
HEATHMAN & CO.
10, Parson's Green, London, S.W.

FINANCIAL NOTES.

CHADBURNS (SHIP) TELEGRAPH COMPANY.—Interim, 6% per annum, for half-year ended September 30.

* * *

MANILLA ELECTRIC RAILWAY AND LIGHTING CORPORATION.—One per cent. for the quarter ending December 31.

* * *

WINNIPEG ELECTRIC RAILWAY COMPANY.—A quarterly dividend at the rate of 10 per cent. per annum is payable on January 2.

* * *

MANX ELECTRIC RAILWAY.—The second half-yearly dividend of 2¾ per cent. on the Cumulative 5½ Preference shares has been paid, and a balance of £236 carried forward.

* * *

LA COMPANIA DE GAS Y ELECTRICIDAD DE LA HABANA.—The numbers are published of the 5% Debentures which have been drawn for redemption at par on January 2, at the offices of Messrs. Greenwood & Company, 28, Austin Friars.

* * *

MELBOURNE ELECTRIC SUPPLY COMPANY.—Gross profit for the year ended August 31 was £21,302, which, with the dividend on the holding of shares in the Adelaide Electric Supply Company, is raised to £28,428. The dividend on the First Preference shares is paid, and £5,000 transferred to depreciation and general reserve account. Suspense account is written down by £1,966, and £3,352 carried forward.

* * *

SHAWINIGAN WATER AND POWER.—A quarterly dividend of 1 per cent. has been declared on the Common stock of the Shawinigan Water and Power Company, payable January 20, to holders of $7,000,000 of old stock of record, January 7, 1911. Fully-paid provisional certificates for $500,000 of new stock, issued to shareholders on October 15, 1910, will be accepted for registration in Montreal on or after January 9, 1911, and the above dividend will be paid to the registered holders of such shares of record, January 25, 1911.

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PATENTS.

Three Push-Button Electric Switch.

12490.—1910. H. E. DEY, Jersey City, U.S.A. One button causes the driven mechanism of the switch to move in one direction, the second button reverses the movement. The third button restores the mechanism to its original position.

Dynamos.

4758.—1910. J. DE COSTER, Thildonck. The current produced in the dynamo is held at constant voltage and amperage by means of a regulator combined with a field rheostat. The regulator actuates a pivoted lever connected to one brush of the dynamo and intended to be moved when the dynamo reaches a suitable speed upon a contact plate connected to one pole of a secondary battery, the circuit of which includes lamps to be supplied with current and the second pole of which is connected to the second brush of the dynamo, the contact lever being moved at the same time over the contact pieces of a suitable rheostat.

Producing High Frequency Oscillatory Currents.

7184.—1910. F. JACOVILLO, Parma. The device comprises a high potential arc and a gas jet driven along it to follow the path of the ions. The arc is operated on a high voltage. The gas may be supplied through hollow electrodes suitably cooled.

Magnetic Clutch.

8294.—1910. L. DUTHIEL AND R. CHALMERS & COMPANY, Paris. A lightly-constructed wheel is employed keyed on the shaft to constitute the engine flywheel. The flywheel forms one member of the clutch. The other member consists of a sprocket wheel which is brought into contact with the flywheel portion when an electric current circulates in the coil.

Electric Heating Apparatus.

10097.—1910. H. LOFQUIST, Stockholm. The apparatus comprises heat resistance elements, walls of steatite surrounding those elements and levers operated by a contact thermometer for breaking the current through the elements when the temperature in the apparatus has reached a predetermined degree for the purpose of obtaining efficient heat during a long period with a low consumption of current.

Reinforced Telegraph Poles.

10676.—1910. R. ESPARZA, Andosilla. The framework comprises two rims of different dimensions with uprights secured to them. Spirals connected with the rims are wound round the uprights. The framework is embedded with concrete or cement.

Search Light.

11054.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. A metal reflector is arranged behind the glass reflector in such a manner that the two reflectors have a common focus. If the glass should be broken the metal will reflect the light of the electric arc in nearly the same manner and angle as the remainder of the glass reflector, and serve until the glass can be conveniently replaced.

Terminals.

11277.—1910. EVERSHED & VIGNOLES, LTD., S. EVERSHED AND H. J. PAYNE, Chiswick. The terminal comprises a base provided with a guiding hole for receiving the electrical conductor, but not taking part in the clamping operation, a loose clamping piece mounted on the base so as to be restrained from any rotary movement, and a screw tightening device by which the clamping device can be tightly held down upon the base so as to grip the conductor in a rigid manner.

Controllers for Electric Machinery.

11437.—1910. H. B. VAN DAALEN, Maida Vale, W. The invention consists in the provision of a single reversing lever to effect the reversal of the direction of vehicles and in the provision of means for preventing the movement of the reversing lever unless and until the controller is in its neutral position.

Working Arc Lamps and Incandescent Lamps in Common on an Alternating Current Circuit.

11583.—1910. A. HEIMANN AND W. SCHAFFER. This is a modification of patent No. 748, 1910, noted previously, and consists in connecting the circuits so that at first only the circuit comprising the variators and incandescent lamps connected in series is switched in without the arc lamps, the arc lamps being switched in only after the heating of the variators.

Movable Coil Alternating Current Transformers for Supplying Current of Constant Value.

13015.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. This transformer which is specially intended for supplying single arc lamps is provided with movable windings which alter their position with regard to the fixed windings to to small changes in the current of the secondary circuit The movable windings are made of light metal.

Electric Rotary Transformers.

5938.—1910. W. HOSKINS, Seattle, U.S.A. This transformer comprises an armature having a re-entrant winding, a commutator in connection with the winding, and an additional winding carried by the armature and tapped into the re-entrant winding, and collector rings having mechanical connection with the commutator and connected to the additional winding.

Starting Arrangement for Single-Phase Alternating Series Current Motors.

18848.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. According to this method the voltage is at first only applied to the brushes while the exciting windings are cut out, the compensation winding is short-circuited and the brush axis is at right angles to the axis of the compensation winding. The brushes are then gradually moved from the neutral position and when sufficient speed has been attained the compensation winding is included in series with the armature and exciting windings and the brush axis is then placed in the same direction as the axis of the compensation winding.

Control of Electric Motors.

22708.—1910. F. E. CASE, Schenectady, U.S.A. In this control system a reversing switch is provided which is adapted to be operated electrically or by fluid pressure is controlled by valve mechanism connected to the reversing handle of the controller.

Liquid Controllers for Electric Motors.

21595.—1909. J. A. LIDDLE, Edinburgh. An electrical conducting liquid and an electrical insulating liquid of such nature that they will not form a compound, are mixed so that the liquid between the electrodes is of much lower resistance than that of the insulating liquid. When the liquids are allowed to settle they at once separate out and, owing to the position of the electrodes, the insulating liquid always fills the space between the electrodes, thus cutting off the passage of electric current. By mixing the two liquids, the amount of current passing between the electrodes can be controlled at will.

Electro-Magnetic Preserving Apparatus.

23040.—1909. ELECTRIC MEAT CURING COMPANY, Cleveland, U.S.A. The apparatus has a receptacle for containing a liquid which is an electrolyte and a substance to be acted upon. An electric current is passed through the liquid. An electro-magnet is so arranged that its lines of force pass through the receptacle transversely of the path of the current, while the pole faces of the magnet are maintained out of contact with the electrolyte.

Make and Brake Switches.

23224.—1909. J. WILSON, Tottenham. The switch is operated by the falling over of an unstable weighted pivoted arm which is moved over its dead centre on either side alternately by the rising or falling of a mercury column connected with a closed gas-chamber containing a heating coil in the switch circuit.

Operating Ships' Rudders by Electricity.

25365.—1909. SOCIETA ANONIMA ITALIANA GIO, ANSALDE, ARMSTRONG & COMPANY, Genoa. The apparatus comprises an electric motor for operating the rudder, a dynamo for supplying current to the motor, and means for automatically and simultaneously regulating the excitation of the motor and the dynamo. This causes the motor to exert a torque on the rudder which will vary automatically with the angle through which the rudder is turned.

Electric Driving.

25586.—1909. E. R. ELLISTON & H. MARRYAT, London, E.C. In order to obtain a wide and gradual range of speed, two electro-motors, shunt or compound wound, are constructed and adapted to develop the same power at speeds bearing the ratio of two to one. The armatures of the two machines are mounted on the same shaft and coupled direct.

Operating Electrical Switches on Three-Wire Systems.

25668.—1909. F. FERNIE, Edinburgh. According to this method the frequency of the current is varied from a single source of alternating electromotive force with or without the employment of an actuator.

Alternating Current Dynamo Machines.

25785.—1909. C. A. PARSONS, & A. H. LAW, Newcastle-on-Tyne. The machine has a small auxiliary exciter provided with leakage paths. The windings are supplied with current proportional to the main current of the alternator. The auxiliary exciter operates in conjunction with the main exciter to regulate the current in the windings of the alternator.

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ADVERTISING ELECTRICITY.

An Original Leaflet.

The Electric Supply Publicity Committee have just issued a leaflet on electric lighting, which is undoubtedly on most original lines, and is got up in a very artistic and striking form. We are giving an illustration of the outside cover, from which our readers will see that the keynote is struck in a very original way. The vigorous little sketch is by a well-known poster man, Mr. Charles Crombie, and has certainly added to his reputation. The letterpress of the inside pages carries out the theme and is written in a terse and vigorous style to correspond. The circular is intended for non-consumers, especially for those somewhat laggard people who are not struck by an idea unless it is put in very forceful language.

There is no doubt that electric supply would go forward very quickly if it were not for antiquated ideas of its expensiveness being abroad. This circular ought to do much to dissipate such ideas.

The committee also include in the issue a booklet for shopkeepers, pressing home the point how to increase their business. The booklet is eight-paged and illustrated by some of the best specimens of up-to-date lighting. It forms an extremely attractive circular and just the thing for canvassers to make good use of when calling on non-consumers, and also for sending out to all those shops that stick to the old-fashioned illuminant, much to their own detriment, as this booklet very convincingly shows.

The shopkeeper who can resist the very cogent arguments inside this booklet must be a very prejudiced person indeed.

LEGAL.

Right of Supply to Corporation Tramways.

In the Chancery Division on Saturday, Mr. Justice S. Eady delivered judgment in the case of the Newcastle Electric Supply Company, Ltd., *v.* The Newcastle Corporation.

The plaintiffs asked the Court to declare that after August 6, 1910, the defendants were bound to take from the plaintiffs all the electric energy reasonably required by them for working or lighting the cars upon such of the defendants' tramways as were or hereafter might be constructed in the district which was formerly the urban district of Walker, at a price to be fixed, failing agreement, by arbitration, and that the defendants were not themselves entitled to supply electrical energy for the purpose. The plaintiffs also claimed an injunction, following upon this declaration. The defendants denied the right sought to be established by the plaintiffs.

His Lordship said that the short point which had arisen for his decision was whether the defendants were under a contract to take from the plaintiffs electric current required for working and lighting the tramways in Walker. The Walker Urban District Council obtained a provisional order giving them powers to supply electricity, and, by an agreement of July, 1900, made between the Walker Council and the plaintiff company, it was agreed that the plaintiffs, for a term of 10 years, commencing from August 6, 1900, should take upon themselves the responsibility, obligations, and liabilities of the supply of electrical energy within the Council's district under the Walker electric lighting order. By their defence, defendants said that they were now the Walker Council, and they agreed and consented that the Corporation should supply electrical energy. If the Walker Council would not consent, as, clearly, they could not, then the defendants, as the Walker Council's successors, could not consent either. It was contended that the words "transmission" and "user" were equivalent to "supply," but he was of opinion that clearly those words had no reference to "supply." The words "supply," "transmission," and "user" were all well known, and were frequently used in agreements relating to electrical energy, and "supply" was a wholly different thing from "transmission" and "user." The construction of the agreement was clear, and the Corporation were bound to take the supply of electrical energy from the plaintiff company. The result was that there would be a declaration to that effect. There would, however, be a suspension of the injunction for a reasonable time, he would say till over January 13 next, to enable the necessary connections of supply cables, etc., to be made. If that time were found to be insufficient, then he would give leave for an application of extension of time to be made.

OIL IMMERSED MOTOR STARTERS.

During recent years it has become a standing complaint with electrical switchgear manufacturers that motor starters are not worth manufacturing, and, unfortunately, in some cases, the low prices have been a temptation to cut quality.

Messrs. A. Reyrolle & Company, Ltd., Hebburn-on-Tyne, have, however, recently put a new line of starters on the market, which, although fully maintaining their reputation for high class workmanship and material, are very much cheaper than the usual run of motor starter for the corresponding powers.

This end, however, has been attained, not by cutting the quality in any direction, but by the closest attention to every detail of the design and the use of the most suitable possible materials. The starters are totally enclosed, as will be seen from the illustration, and the oil-immersed resistances are of a special alloy. These starters are fitted with no-load coils, and a powerful magnetic blowout, which acts upon the whole of the contacts, thus reducing burning to an absolute minimum.

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THE "ELECTRICAL ENGINEER"
TECHNICAL BOOK DEPARTMENT.

In response to the request of a very large number of subscribers and readers at home and abroad, THE ELECTRICAL ENGINEER has organised a Book Department, through the medium of which their professional needs in this respect can be met with a minimum of trouble and expense. Subscribers in any country within the Postal Union can obtain the volumes here enumerated, post free, on remitting the published price to The Manager, Book Department, THE ELECTRICAL ENGINEER 149, Fleet-street, London, E.C.; together with the sum of threepence in respect of books published at from 5s. to 10s. 6d., and of sixpence for all volumes published at a higher price. Any work not mentioned in the published lists will be sent to any part of the world on the same terms. In ordering, it will only be necessary to mention the KEY NUMBER appended to each entry.

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STANDARD ELECTRICAL WORKS.

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NOTES.

Electricity in Mining.

Recently we have had quite a number of important papers dealing with electrical practice in mining. Mr. Hickman, of Ripley, Under-Manager at Pentrick Colliery, in giving a comprehensive survey of the subject before the Nottinghamshire Mining Students' Association, stated that there were to-day 777 electric coal-cutting machines being worked in coal mines in England, and some 80,000 persons came in contact with them. Out of 23 persons who had lost their lives whilst working these machines, nine deaths were caused through the ignition of gas by electricity. At Wingfield Manor Colliery, Derbyshire, two fatal accidents of a similar character had occurred within the last three months.

Automatic Cut-Out.

Before the North of England Mining Engineers, Mr. George J. Ralph dealt with the Holmes-Alderson automatic fire-damp cut-out, which has already been described in these columns. Mr. Ralph said that the use of an apparatus of this kind rendered the use of electric motors safe even in situations where gas was liable to accumulate, without it being necessary to enclose them in a flame-proof manner. Such enclosure involved the use of very much larger, heavier, and more expensive motors for a given horse-power than would be the case otherwise; in fact, the output of a motor was reduced to about one-half when totally enclosed. The Holmes-Alderson automatic fire-damp cut-out had been designed to detect the presence of fire-damp, and, in conjunction with suitable relay cut-outs, to interrupt the supply of electrical energy to motors or other apparatus in the neighbourhood as soon as, or before, fire-damp was present in sufficient quantity to render the use of such energy a source of danger. It was, at the same time, adapted to give warning of the fact by a visible or audible signal. It was sufficiently sensitive to operate in a 2% mixture of gas and air, but it might be set for any larger percentage. It was equally applicable to direct-current and alternating-current circuits, and consumed between one-half and three-quarters of an ampere. In a case where gas had accumulated to such an extent that an accidental spark or flash at the motor or its controlling gear might cause a disastrous explosion, a fire-damp cut-out, if installed near the motor, would operate before the atmosphere surrounding it reached an explosive condition, cutting off the current from the circuit, and lighting up a red lamp as a danger-signal.

Yarn Singeing by Electricity.

Another triumph of electricity in textile manufacture has to be recorded. The singeing of yarns has hitherto been carried on by the process known as "gasing." But with this operators have to contend against difficulty of control and fouling of the air. Now Messrs. E. Lacharriere & Company, of Manchester, are introducing a machine for yarn singeing by electricity. The actual burning takes place in an insulated platinum alloy tube, electrically connected. The fluff and upstanding fibres are quickly removed, without in any way damaging the yarn itself. The process is quick and clean, and, of course, gives off no evil fumes. Considering the rapid progress made in the introduction of electricity in both spinning and weaving on the Continent of Europe, it is, perhaps, not astonishing, though rather disappointing, to find that this extremely ingenious apparatus stands to the credit of a foreign inventor. Abroad, we understand, close upon 2,000 burners are in use for singeing wool, cotton, spun silk and other yarns.

Copper in 1910.

Messrs. Bolling and Lowe, in their annual report on the metal market, rather lament the fact that it has been impossible to keep up prices for copper at an abnormal figure. So far, happily, all attempts of coming to a working understanding between European and American producers have failed, and for the good of industry generally, and electrical engineering in particular, we hope that present rumours of an arrangement between the financial groups controlling the chief sources of output may prove equally fallacious. This year the price has fluctuated between £62 1s. 3d. and £52 15s. per ton, which is not high as things go of late, but the fluctuation of over £9 per ton in the space of a few months is unhealthy for manufacturing engineering. Nevertheless, the demands by consumers have been steadily on the increase. Messrs. Bolling and Lowe state that during the coming year Russia is likely to become an exporter of electrolytic copper, as the development of properties and plant in that country has now reached a point where an exportable surplus is available.

BOOK REVIEWS.

"Elementary Telegraphy," by H. W. Pendry, of Central Telegraph Office, London. Whittaker & Company. 2s. 6d. net.

This little book of 200 pages and illustrations has been written specially to meet the requirements of the ordinary grade of the subject as published in the syllabus of the City and Guilds of London Institute. It has numerous calculations such as students must be able to make quickly in answering questions. All the various types of telegraph apparatus are described, and the diagrams of connection are particularly clear. The principle of the bridge duplex, with examples of relative resistance, is gone into fully. At the end of each chapter there are suitable questions, and at the end the questions set by City and Guilds of London Institute for 1908-9 and 1910.

"Technical Dictionary in Six Languages": German, English, French, Russian, Italian and Spanish, by A. Schlomann. Vol. X., dealing with motor vehicles, motor cars, motor boats, motor air-ships, flying machines. Edited by Rudolf Urtel, and published with the authority of the Royal Automobile Club of Great Britain. Constable & Company. 12s. net.

It is impossible to speak too highly of this dictionary. In arrangement, size of volume, illustrations, printing and binding it is all that a polygrot technical dictionary should be. It is not merely a dictionary, because formulæ are given in full, and the drawings would do credit to any book on mechanical design. The method of treating a complex piece of mechanism, as, for example, an air valve, is first to give a full sectional drawing with all the various parts lettered; then to give below, opposite each letter, the name of the part in six languages. There are chapters giving terms used in sport and purchase, sale and shipping. Of the total 995 pages, no less than 370 are taken up by the index. Russian is given in the text along with the other languages, but in the index it is treated separately. No up-to-date business house or manufacturer can afford to be without one or more of these volumes.

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SWITCHGEAR AND THE ISOLATION OF FAULTS ON POWER SUPPLY SYSTEMS.

(Paper read before the Institution of Electrical Engineers, Newcastle Local Section.)

H. W. Clothier.

Objects of Paper.

In the construction of high tension systems for general power purposes it is essential to provide for the disconnection of faulty parts and to make this operation automatic when faults are so serious as to be a source of danger to life, property, or to the continuity of supply. In consequence switchgear controlled by automatic devices has been evolved. It may be safely claimed that in recent years the design of such apparatus has reached a stage when it can be relied upon to operate with precision, but doubt often exists as to what system of protection to adopt. It is, therefore, of interest to consider what experience has shown to be essential on a large power supply undertaking, and this is the object of the following paper.

Leading Considerations.

As in all apparatus, the primary considerations governing the design of successful automatic switchgear are :—

A thorough understanding of the functions which the apparatus has to perform,
A rigid elimination of unnecessary parts, and
A construction affording maximum security with minimum supervision and maintenance.

Functions of Automatic Switchgear.

The true functions of automatic switchgear are the requirements imposed upon it by the general lay-out of the system as a whole. While it is not the purpose of this paper to consider the lay-out of high tension systems in detail, it is necessary to briefly review the principles in order to have a basis upon which the switchgear requirements can be considered.

Lay-out of High Tension Systems.

The guiding principle in the design of a large high tension power system (in so far as affects automatic switchgear) may be summarised in the statement that the whole of the plant must be so arranged that failure of an individual part due to accidental injury shall not affect the supply to a single consumer. This condition calls for the instantaneous isolation of faulty parts, and such an arrangement of parts as to avoid breakdown on one affecting another.

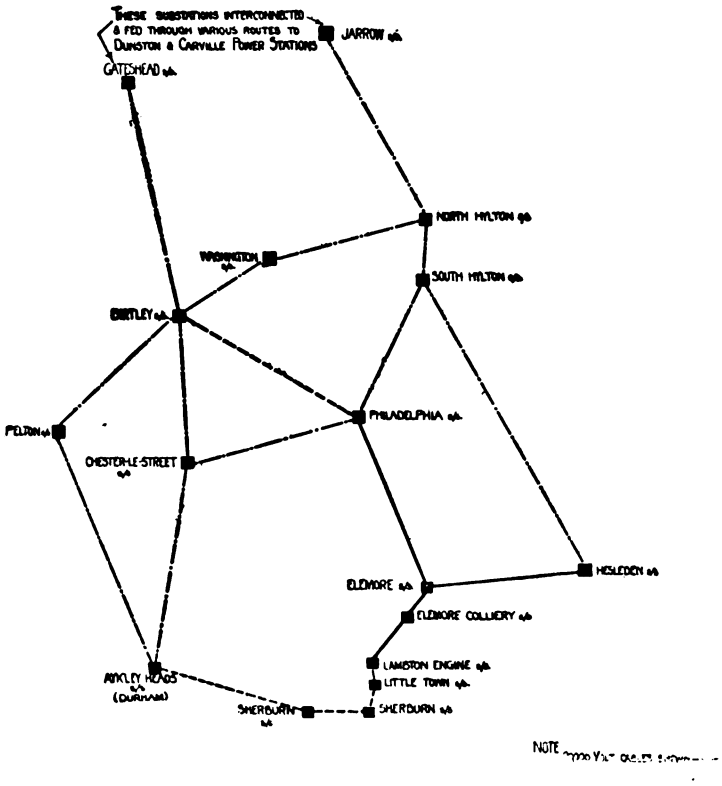

FIG. 1.—EXISTING HIGH-TENSION NETWORK.

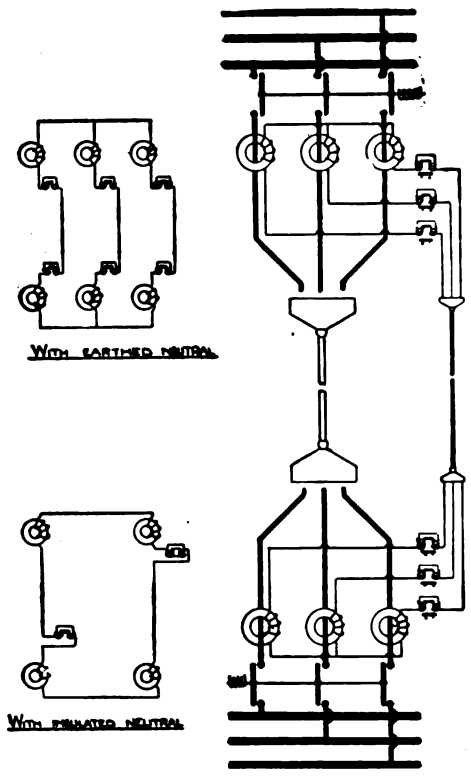

FIG. 2.—FEEDER PROTECTION—E.M.F. BALANCE.

The only practical way to attain these objects is to subdivide the generating, transmitting, and transforming plant, so that in the event of failure of one sub-section the remainder will have sufficient overload capacity to continue the service; each sub-station being controlled by automatic switchgear inserted at the junction points between it and others. It is possible by carefully arranging the relative positions, etc., of generators, cables, transformers, etc., to ensure that one will not damage another by fire or impact when under breakdown conditions, but it is a comparatively difficult problem to guard against injury to one part of the plant from some abnormal condition of the load occasioned by a short-circuit or faulty operation of another part. Probably the scope of the switchgear in this respect is limited to the quick removal of the abnormal conditions by isolating the faulty part, although there may be other solutions, such as the automatic insertion of devices to limit the amount of current passing through a short-circuit.

The possibility of one part of the switchgear itself failing and injuring another is essentially a switchgear problem, but it should be taken into account when considering the lay-out of the whole system together with the fact that a bus-bar fault, or the failure of a switch to act when required, is equivalent in its effect to the breakdown of a number of sections. In order to provide against such contingencies causing a shut down to the entire system the network should be split up into a number of self-contained areas inter-connected in such a way that they can be automatically divided on the occurrence of a bad fault without seriously affecting the distribution of the load.

The automatic switchgear should not rely solely for its successful operation on a particular lay-out or feature in the lay-out of the plant, as it is often necessary in making extensions to alter the lay-out, and, moreover, it will be generally found in practice that special arrangements of cables, etc., to suit requirements of protection, can only be attained by materially increasing the capital expenditure, and, therefore, it is better to first determine the most economical lay-out of the plant and then to provide switchgear to suit. For example, Fig. 1 illustrates an existing high tension main's network, consisting of a multiplicity of interconnected cables, each following individual routes and tapping as many sources of demand as possible. As ordinarily one cable is cheaper than two for the same service, duplicate cables over the same route should be avoided, except when the load be larger than can be dealt with by the most economical size of cable. This network, therefore, includes ring mains, and in order that

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the copper shall be used to the best advantage each ring is closed; thus there are no idle cables. Idle cables as a stand-by supply represent idle capital, and, moreover, there is always the disadvantage of a delay in changing over after the occurrence of a breakdown, whereas the closed ring main provides a supply to each sub-station along duplicate routes and a suitable protective system ensures the automatic isolation of any single cable without interrupting the supply to the sub-stations.

Essential Considerations in Switchgear Design.

In the light of the above the requirements of switchgear considered from a protection point of view may be stated as follows:—

Reliable automatic operation under fault conditions.
Inoperative, whatever the condition of the load, while the section which it protects is sound.
Freedom from risks of shocks and burns.
Freedom from breakdown under all working conditions.
Reduction of cleaning, testing and supervision to a minimum.

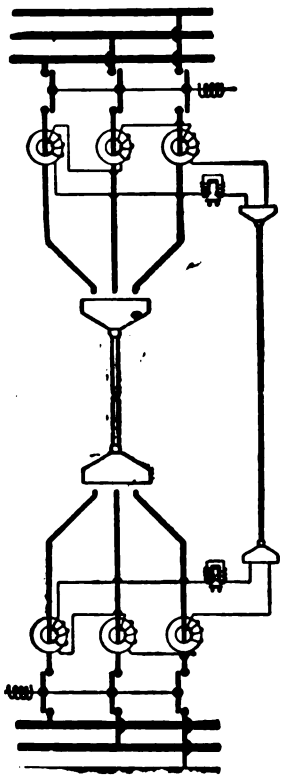

FIG. 3.—FEEDER PROTECTION—E.M.F. BALANCE, TRANSFORMERS CONNECTED REVERSE DELTA.

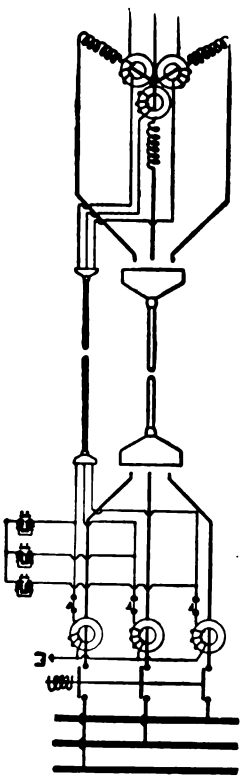

FIG. 4.—GENERATOR PROTECTION—CURRENT BALANCE.

Robustness of construction to withstand all kinds of rough usage and to eliminate fire risks.
Ready access to those parts where regular inspection is unavoidable, and
Protection against shock by the automatic isolation of such parts before it is possible to handle them.

There are numerous types of switchgear in which several of these points have been given careful consideration, but, on the other hand, there are few which combine all the requirements. In particular the reduction of cleaning, the robustness of construction, and the protection against shocks and burns specially during cleaning, inspecting, adjusting, or repairing, are some of the items frequently overlooked in apparatus otherwise well designed.

Common Practice in Switchgear Construction.

It is a common practice to install the various parts forming the switchboard inside cubicles constructed of cement or brickwork, thus providing fireproof divisions between the bus-bars and the remaining apparatus. In many cases the building containing the switchgear resembles a warehouse, the separation of parts being carried to the extent of allotting different floors and galleries to the respective parts; for example, the basement for cables and dividing boxes, the engine room floor for transformers, the first floor for switches and instruments, and the floors above for bus-bars. The connections between the parts

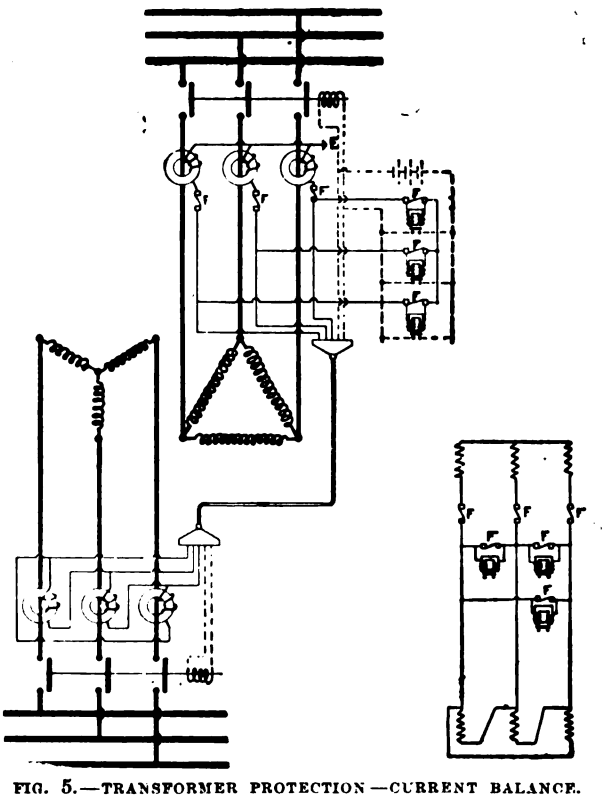

FIG. 5.—TRANSFORMER PROTECTION—CURRENT BALANCE.

consist of bare wires, or cambric or rubber insulated cables, which are threaded through porcelain insulators. Such apparatus has the advantage of having its parts readily accessible, but usually it calls for cleaning at frequent intervals, and not only is this expensive and inconvenient to arrange, but experience shows that, sooner or later, someone is apt to begin work on a live panel with serious results. It has also the disadvantage of occupying a large amount of room and involving expensive building construction, more especially so when to guard against engine-room accidents, such as the bursting of a steam pipe, it is necessary to wall off the switchgear from the engine-room.

Many efficient forms of oil break switches are in use, and these rarely, if ever, fail to open circuit at the sparking contacts provided the mechanism of the switch is in proper working order, and the contacts are well immersed in oil, but when opening circuit under very severe fault conditions, a considerable volume of vapour is formed

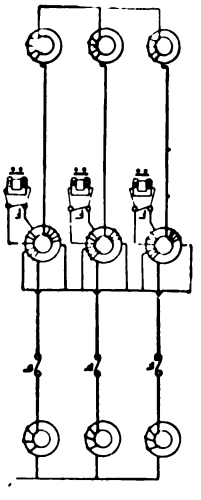

FIG. 6.—TRANSFORMER PROTECTION WITH RELAY BALANCE TRANSFORMERS — MAGNETIC BALANCE. (SHOWING SECONDARY CONNECTIONS ONLY FOR SIMPLICITY.)

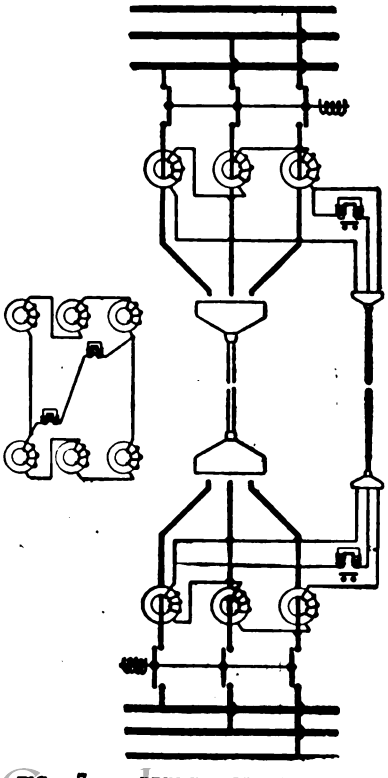

FIG. 7.—FEEDER PROTECTION—NEUTRAL WIRE METHOD.

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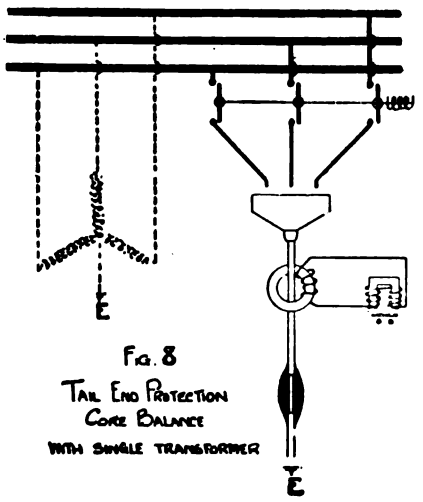

FIG. 8.—CORE BALANCE OR LEAKAGE PROTECTION. (WITH SINGLE RING TRANSFORMER.)

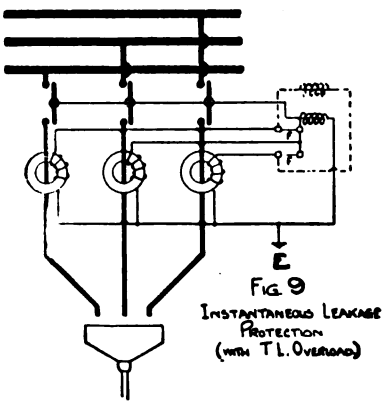

FIG. 9.—CORE BALANCE OR LEAKAGE PROTECTION WITH THE ADDITION OF TIME LIMIT OVERLOAD PROTECTION.

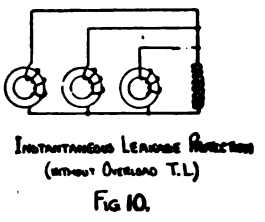

FIG. 10.—CORE BALANCE OR LEAKAGE PROTECTION WITH THREE CURRENT TRANSFORMERS.

and as this includes vapourised metal from the sparking contacts it lowers the insulation between all conductors in its immediate vicinity, and so tends to produce shorts between neighbouring conductors. On one occasion a switch, while acting on a short, happened to be under close observation when flames and smoke were ejected through the joint between the tank and the top plate, and an arc simultaneously leaped across the exposed terminals above the switch, thus introducing a bus-bar fault of a serious nature. Unless the conductors are so partitioned from one another as to effectually separate all metal of differing potential, the enclosure of switches in cubicles only aggravates this trouble as it tends to confine the vapour to a limited space. The better precaution is to cover up all the bare conductors in the neighbourhood of the switches.

In the best switchgear the insulation, separation and enclosure of the bus-bars has been very carefully studied, it being the practice to enclose each bus-bar in a separate concrete chamber. In this form the risk of a fault on the actual bus-bar would appear to be very remote, but it must not be overlooked that a fault on any conductor which is joined to the bus-bar and not separable automatically from it, is just as serious, and so to be consistent the good quality of insulation required for the bus-bar must also be extended to all the other parts thus concerned.

It has been a standard practice to provide means for disconnecting the conductors of each panel from the bus-bars and isolating switches or plugs are used for this purpose. In some designs elaborate interlocking arrangements are included to eliminate the risk of error in manipulating these isolating switches, but such arrangements are not always convenient or possible, and there are instances on record of power stations being completely shut down owing to mistakes rendered possible by the absence of efficient interlocking devices. The similarity in appearance of all panels opens up the possibility of a person accidentally entering a live panel, mistaking it for one which has been isolated. Locking off bars and "danger" boards are used to reduce these risks, but more positive methods than these are considered necessary to ensure safety.

There is some justification for the consternation felt in a power station when isolating switches blow out automatically. This circumstance has been experienced owing to the abnormally heavy current occasioned by a short close to large generating plant, and for this reason it has been found necessary to lock all switches having a right-angle bend in the path of the current.

It is sometimes said that safety is best attained by making the presence of danger obvious, and acting on this principle many switchgear designs have been made with no pretence at the enclosure of live conductors. Whether the principle is sound or not from the point of view of safety to human life, it certainly does not afford immunity from faults occasioned by some foreign substance causing a short; many a rat has been pickled in a bottle as a

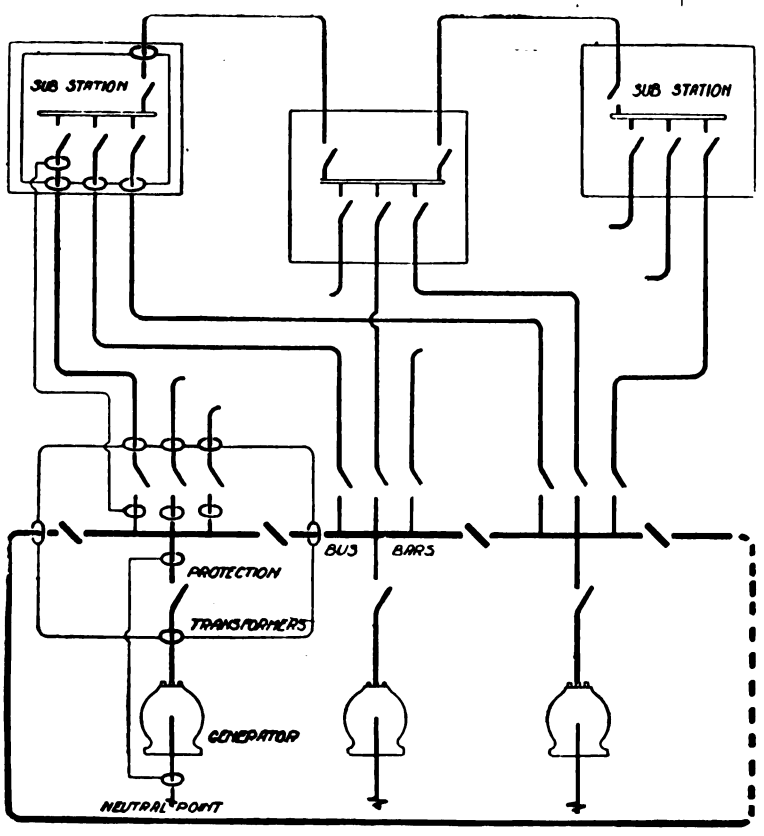

FIG. 11.—BUS-BAR PROTECTION.

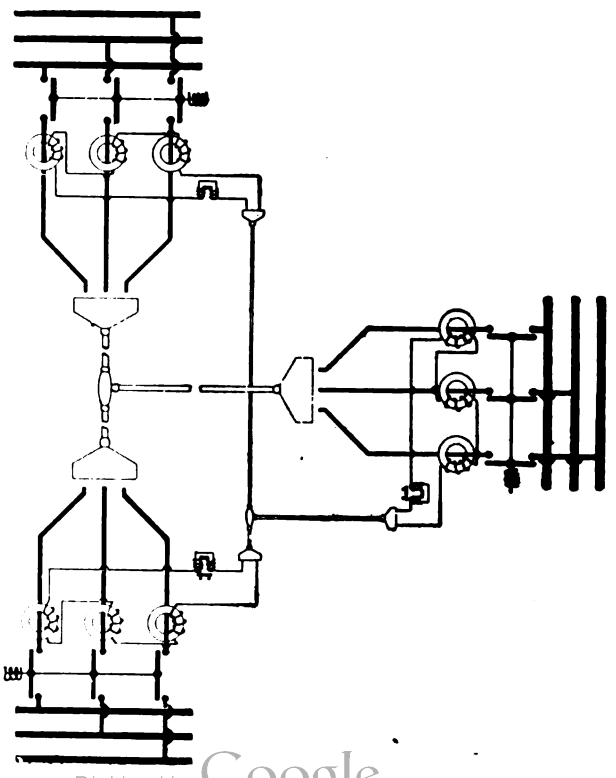

FIG. 12.—FEEDER PROTECTION (E.M.F. BALANCE), WITH TEE

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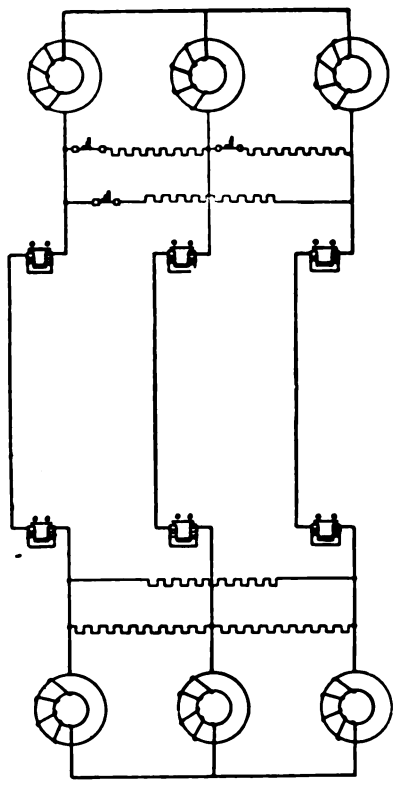

FIG. 13.—FEEDER PROTECTION (E.M.F. BALANCE)—TRANSFORMERS WITH SHUNTED SECONDARY. (TO INCLUDE TIME LIMIT OVERLOAD PROTECTION.)

memento of an intrusion which has been as disastrous to the continuity of supply as to the life of the rodent.

The Equipment of a Switchgear Panel.

It is necessary to consider what is the irreducible minimum of equipment required in ordinary circumstances, and how far is it possible to avoid using parts which are inherently weak, however carefully made.

The principal features controlling the mechanical construction of the switchgear are—bus-bars, circuit breaker, and the discriminating devices operating it. There is so little variety in the construction of the bus-bars that discussion on this point is limited to the material used, and the choice of a circuit-breaker is practically confined to an oil break switch. Under these conditions the considerations upon the design of the panel resolve themselves into a study of the types of discriminating device. Those which have been most generally used are overload devices (including a variety of designs, some operating instantaneously, and others with time element) and reverse current devices (also with and without time element devices), but so far the most satisfactory discriminating device which has been tried on a large scale and found reliable to operate with certainty when required and to remain inoperative when not required, is the "Merz-Price" system of balance protective gear.

The use of graded time limits in series has had an extensive trial as a discriminating system, but unfortunately this system has often failed on important high tension transmission networks. It has the disadvantages that it cannot be used on a ring main, it is opposed to the principles of instantaneous release, and it is difficult, if not impossible, to predetermine the correct settings of relays at various positions on the system in order to isolate with certainty a faulty section without shutting down any of the healthy ones, *i.e.*, it lacks discrimination.

Reverse current devices have been tried and have also been found wanting, the principal difficulty being to make them inoperative when faults occur on sections other than those which they are intended to protect. They are also useless, of course, as a means of protection in situations such as ring mains, when the flow of power may reverse under normal conditions.

Balance Protection.

In the system of balance protection the criterion of operation is that, while a section is sound, the current entering it must be identical with that leaving it (excluding a very small amount due to capacity). Current transformers are installed at the entries and exits of each section, and a balance of their electrical properties is obtained. In the event of a fault or leakage occurring, the current leaving a section differs to that entering; the balance is thereby disturbed, and by means of relays the circuit breakers are automatically opened at the ends of the faulty section.

Three methods of connecting this system have been adopted—E.M.F. balance, current balance and neutral wire balance.

The connections of the former are as shown on diagrams (Figs. 2 and 3). The balance is obtained by having the E.M.F. at the secondary terminals of the current transformers in opposition, that is to say, under normal conditions no current flows through the pilot wire.

The connections for "current balancing" are as shown on Figs. 4, 5 and 6. The secondaries of the transformers are connected uni-directional, *i.e.*, under normal conditions current flows through the pilot system in direct proportion to the main current. There were two systems developed under this category—the first was that shown on Fig. 6, has been called "magnetic balance," and the other that on Figs. 4 and 5, the "bridge" method.

In the third system, called "Neutral Wire Balancing," an example of which is shown on Fig. 7, the secondaries of the transformers are connected uni-directional as for current balance, the neutral wire connects between points of equal potential at the two ends of the section, in this case under normal conditions, no current passes through the pilot system on which the relays are connected.

Time Limit Overload Protection.

In some cases it is desirable to supplement the balance gear with devices for protection against sustained overloads. With current balancing this can be obtained by merely inserting fuses in the secondary protective leads, as shown on diagrams 5 and 6 (a suitable form of construction for these fuses is shown on Fig. 14). The introduction of a time limit device applied to feeder protection with E.M.F. balancing has also been suggested, and Fig. 13 shows the connections.

Balance Gear on Insulated Neutral Systems.

The above diagrams indicate in each instance the connections for three-phase A.C. systems having the neutral point earthed which, considered from a protection point of view, is the most suitable system in that a fault of sufficient magnitude between either of the three phases and earth would operate the relays, and clear the faulty section before further damage is done there or elsewhere. On the other hand protection on an insulated system is simpler; for instance, compared with the connections on Fig. 2, the corresponding connections for an insulated neutral system would have the advantage that there is one less pilot lead and a saving of one current transformer and two relays at each end.

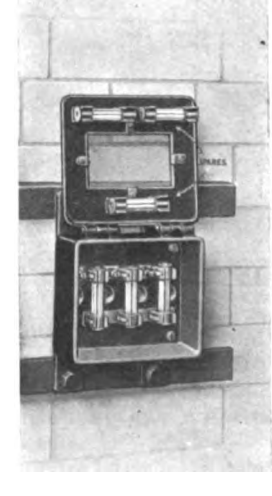

FIG. 14.—TIME LIMIT FUSE BOX.

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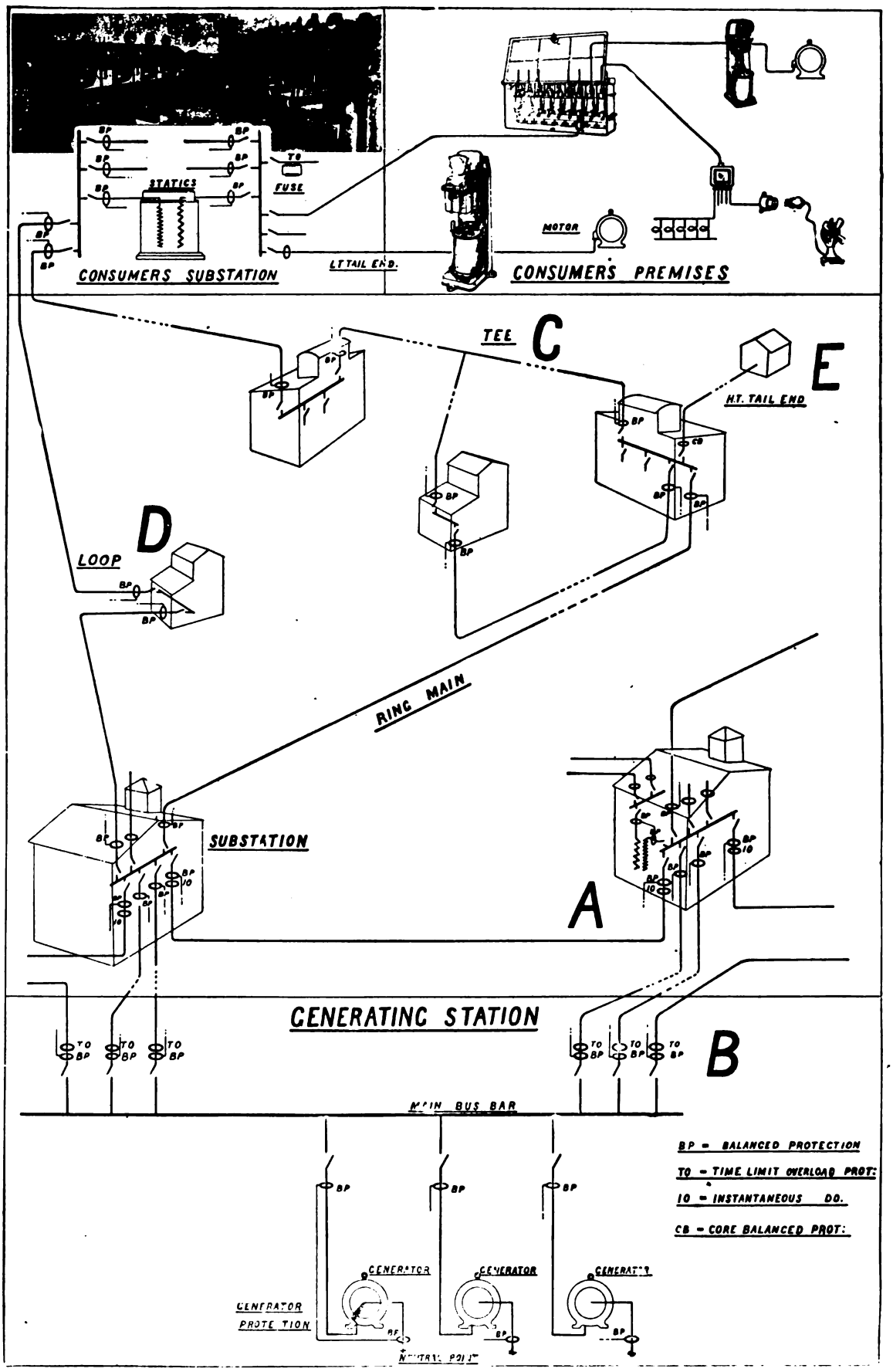

FIG. 15.—DIAGRAM OF POWER SUPPLY LAY-OUT

Leakage Protection.

An interesting development of the balance protective gear is a system which has been called the "Core Balance," or "Leakage" Protection. This system provides for the instantaneous isolation of a circuit on the occurrence of a fault or leakage to earth, and, in common with the other balance protective gear, it is inoperative on ordinary overloads; moreover, it has the advantage that no pilot wire is required. Diagrams of connections are shown on Figs. 8 and 10. It will be seen that a balance is maintained on the relay or trip coil circuit so long as the algebraical sum of the currents in the three cores of the main cable is zero. This balance, however, is disturbed immediately there is a leakage to earth on one or more of the cores, and the switch is thereby tripped, provided the leakage exceeds a predetermined amount.

Time limit protection against sustained overloads or faults between phases is often added by the introduction of fuses and another trip coil; a modification of this nature is shown on Fig. 9. The use of this system is of course strictly limited as a means of protection against faults on high tension networks by the fact that it only

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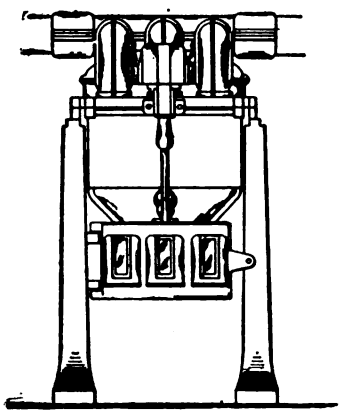

FIG. 16. — ARMOURED SWITCH-GEAR—FRONT ELEVATION.

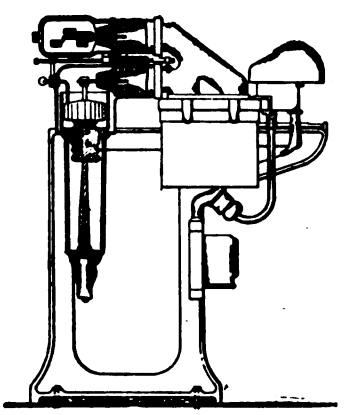

FIG. 17. — ARMOURED SWITCH-GEAR—CROSS SECTION OF PANEL.

discriminates between a fault to earth and an overload, that is, it is quite useless in its present form for ring main protection. It may, however, serve some purpose in the protection of tail ends and for mines and places where sustained arcing is a great source of danger, the system can be applied to advantage in that it offers the possibility of cutting out a fault occasioned by a fall of rock so quickly that no arcing external to the cable can occur.* It has been suggested that as a system of leakage protection it is also possible to obtain some discrimination by grading a number of leakage settings on sections in series with one another, the one nearer the source of supply being set to trip out with the greater amount of fault current, thus following with some prospect of success the principle of one of the earliest forms of protection tried upon large power transmission systems.

Protective Gear Arrangements Generally.

It will be understood that the balance system can be adopted for protection in a great variety of ways. The attached diagrams are intended to show some of these and to indicate the purposes for which they have been found most suitable. On a high tension power supply system the leading considerations concern the protection of generators, feeders and transformers.

Generator Protection.

The principal faults to be considered are :—

(1) A failing field ;
(2) The failure of the prime mover, and
(3) A breakdown of insulation on the armature windings or main connections.

In some large power stations the engineers, preferring to rely upon the alertness of their operators, have no automatic protection on the generators. It is certainly questionable whether any automatic protection is necessary against faults (1) and (2). If, however, it be decided that some automatic protection is necessary, to guard against a failing field only, a relay with a time element can be installed which will open the main switch when a drop in excitation voltage occurs. But if protection is also required against motoring or a failure of the prime mover, a reverse power relay must be resorted to. The latter, however, must be provided with some time element feature to prevent it from disturbing the continuity of supply by isolating its machine at times when momentary reversals occur.

The breakdown of insulation in a generator circuit is a more serious matter as, under these conditions, not only is the supply jeopardised, but abnormal stress is put upon the conductors of the sound machines for several periods. Mr. Myles Walker has drawn attention to the fact that a machine running on a dead short at its terminals may momentarily generate 20 or 30 times its full load current, and from this some idea can be gathered as to the amount of current which would be fed into a generator fault when in a large power station with several machines in parallel.

The ideal generator protection would isolate the faulty machine within a fraction of a cycle without interference with the other machines. The nearest approach to this ideal is obtained by the balance system of protection. The arrangement which has been adopted is shown on Fig. 4 (current balancing). The fuses shown on this diagram may be used for overload protection as previously described (Fig. 14). The usefulness, however, of the fuse in this instance is limited, as under ordinary circumstances it would need to be set very high and could not be considered a sure means of operating in the event of a bus-bar fault occurring ; its chief use is that it permits of a light overload setting on special occasions, such as when a separate machine is running on a test.

Bus-Bar Protection.

The bus-bars must be absolutely reliable in a power station, and they should be so substantial and the insulation so secure that there is no need to provide automatic protection. Fig. 11, however, indicates the possibilities of bus-bar protection, current transformers being placed on each entry to and exit from the switchboard, or any section of the same. These transformers are so connected that a balance in the secondary circuit is maintained under healthy conditions, but immediately a short or an earth occurs on any conductor on the switchboard all the switches connected to the faulty section would be opened, thus isolating the bus-bars and all the electrical connections attached to them. A sub-station switchgear was equipped on these lines and the experience obtained with this was sufficient to prove the principle.

In some power stations elaborate provisions have been made to guard aganist switchgear failures, including the use of group switches, duplicate bus-bars, and in some cases even duplicate feeder and generator panels. It is suggested that, although automatic bus-bar protection in a power station is undesirable on account of the expense and the complications involved, it is nevertheless preferable to some of these other provisions which have been made, the more so on account of its discriminating action.

FEEDER PROTECTION.

Trunk Main and High Tension Feeder Protection.

The simplest arrangement of connections for balance protection on feeders is shown on Fig. 2—E.M.F. balance. This figure illustrates the standard arrangement adopted by the power supply undertakings in Northumberland and Durham.

The setting of the relays at various positions on the high tension network should be determined by the amount of current possible through a fault occurring at the respective positions ; this amount varies with the resistance and inductance between the point where the fault occurs and the generating plant, and also within certain limits with the aggregate power in the generating plants. In order to obtain the best results in the equipment of protective gear each system should be considered in relation

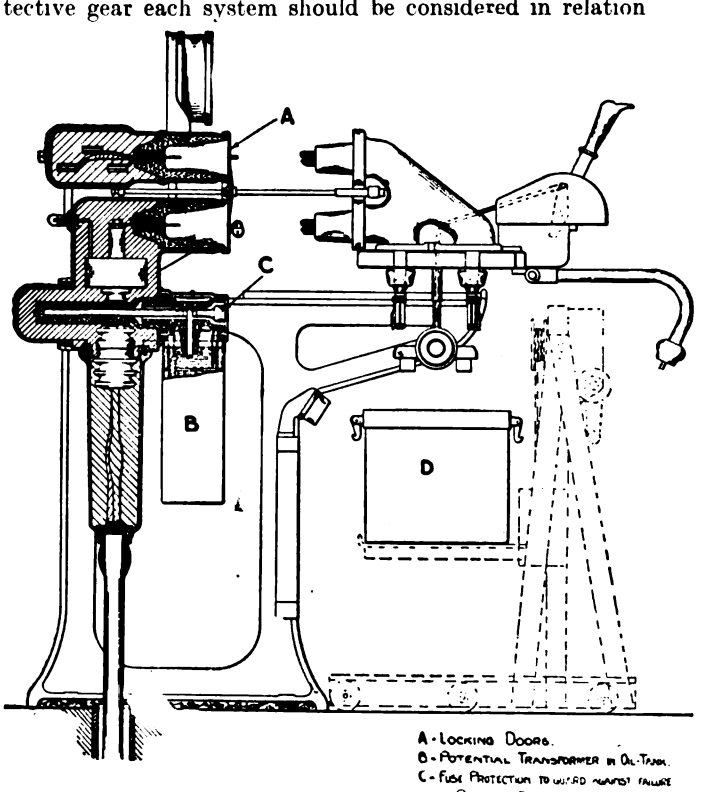
A
C
B
D
A - Locking Doors.
B - Potential Transformer in Oil-Tank.
C - Fuse Protection to guard against failure in Potential Transformer.
D - Switch Oil Tank lowered for inspection of contacts.

FIG. 18.—SIDE ELEVATION WITH SWITCH DRAWN OUT AND TANK LOWERED.

* Mr. Wedmore's paper before the Institution of Mining Engineers.

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to its own conditions. In practice it is usual to have a diagram of each high tension cable network, showing the number and sizes of cables. In addition, a diagram should be kept up-to-date, showing the resistance of each connection, and the approximate amounts of fault current calculated therefrom which would be expected at the several parts of the system in the event of short circuits occurring. The diagram could show two values of fault currents, one for faults between phases, and the other for faults between one phase and earth.

Combined Balance and Overload Protection on High Tension Network.

The adoption of the balance protection on a large system carries with it the necessity for sectionalising the various ring mains and interconnected network by means of overload cut-outs at certain points; for instance, in the absence of some form of protection to automatically isolate a sub-station switchgear in the event of a short circuit occurring on its bus-bars, a heavy current would be fed into the fault. This would lead to a disaster, as the generator and feeder balance protective gear in circuit would remain inoperative. In order to guard against the possibility of a shut-down under such fault conditions, the network is divided into areas which are interconnected (as shown, for example, on Figs. 15 at A) by cables equipped with an instantaneous overload release, and time element overload devices are installed at the generating station end or at other sources of supply to the several areas. (See Fig. 15, B.) With an arrangement of this kind a bus-bar fault occurring in any of the areas by bringing out the instantaneous overload devices separates the areas and leaves the faulty one to be dealt with by the time limit overload devices. As a rule, current transformers are existing for the indicating and integrating instruments, and, in many cases, it is possible to use these transformers for the time limit overload protection. The arrangement, however, shown on Fig. 13, might be used to combine time element overload protection with the balance protection, the secondary windings being shunted by resistances and time limit fuses for this purpose.

Protection of Tail Ends.

An example of what has been termed tail end protection is shown on Fig. 15, at E. In this instance the cable is not duplicated, and the only benefit to be obtained by the use of balance protection would be to guard against the possibility of switching out the cable in the event of a heavy overload or fault occurring on the consumer's premises beyond the high tension cable. In some cases this benefit may not be sufficient inducement to warrant the expense of installing pilot wire for balance protection, and, as described in the foregoing, the core balance or leakage system can be applied to afford instantaneous release for faults to earth and a time element release for overloads or shorts between phases. This system has, therefore, some merits in its favour for use on tail end protection, as it would cut out an earth with instantaneous action and at the same time would resist a transitory overload on the consumer's circuits.

TRANSFORMER PROTECTION.

Diagrams 5 and 6 show connections as applied for the protection of static transformers. In this case it will be noted that current balancing is utilised. Either arrangement admits of the protective current transformers being also used for working instruments, provided, of course, that suitable provision is made to compensate for the impedence of the instrument circuits in order to preserve the balance by having an equivalent impedence on each side of the points of connection to the relays.

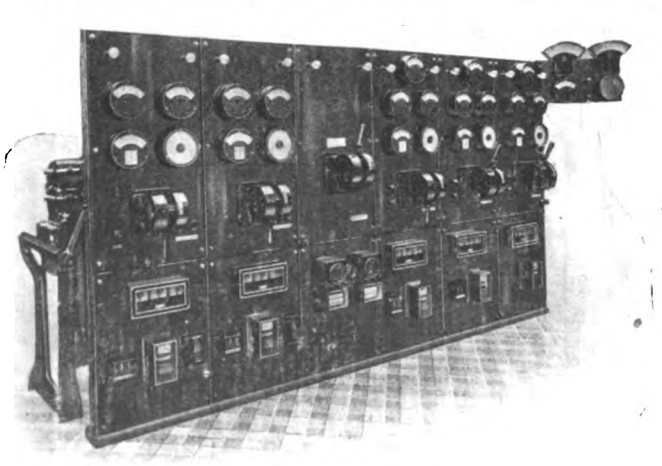

FIG. 19.—CONTROL BOARD.

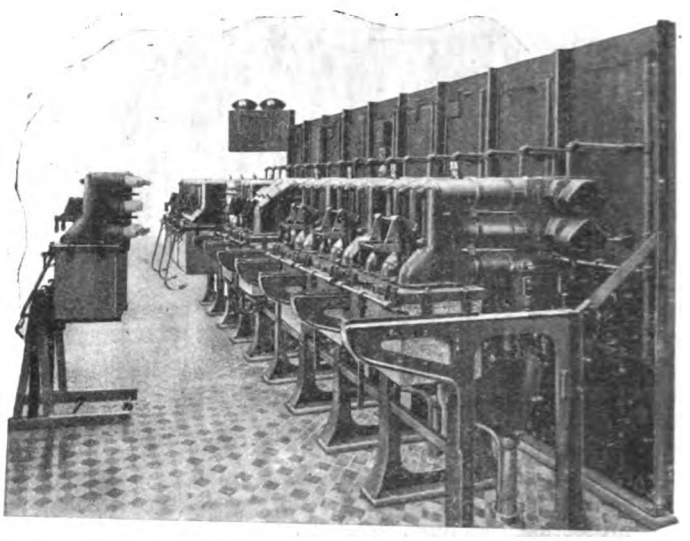

FIG. 20.—ARMOURED SWITCHGEAR WITH DUPLICATE BUS-BAR CHAMBERS.

In the case of static transformer protection, it is desirable to include protection against a sustained overload, such as would be occasioned by a short circuit on the low tension bus-bars. This protection can be obtained by the insertion of three fuses in the pilot leads as previously described and as shown on both of the above diagrams.

In the early development stages of this form of protection it was found that abnormally large magnetising currents were obtained at the moment of switching in. This excessive current was equivalent in effect on the relays to a fault condition. The difficulty was readily overcome by the insertion of a small fuse in parallel with the relay, as shown at F on the diagrams.

The Elimination of Potential Transformers for Protective Systems.

In the foregoing discriminating devices as required at various parts of a high tension system have been discussed. It will be noted that efficient automatic protection throughout is possible, and at the same time it has been possible to dispense with the use of potential transformers for protection, thanks to the systems advocated being operated solely by the products of the current passing through a fault. However soundly potential transformers are constructed they are always liable to be a weak link in switchgear equipment. Consequently in those cases where they cannot be avoided (for example, when no other source for a low tension supply to wattmeter and voltmeter is available), it is advisable to connect them inside a protected circuit and not directly to the bus-bars; preferably they should form a separate equipment attached through a light and reliable fuse to the main body of the switchgear. They should be readily removable, while the main conductors are alive, without the possibility of shocks to workmen, and to give additional security they should, if possible, have the main automatic oil switch between them and the bus-bar.

Simplest Equipment of Automatic Panel.

In view of the above, the irreducible minimum of equipment for an automatic switch panel fitted with balance protective gear consists of bus-bar, circuit breaker, current transformers and relay. Any additional apparatus, however carefully designed, must add to the risk of breakdown and increase the cost of maintenance, and while all designs of switchgear must provide for the addition of voltmeters, power factor indicators, wattmeters, etc., these should not be used on the high tension gear unless absolutely essential.

Protection from Shocks and Fire.

The study of protection against injury to persons from shocks and burns involves careful consideration of all details and the mechanical construction of the switchgear. The same may be said of protection from fire and damage to property (although the latter to some extent also involves

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the study of automatic protective systems as described above). The surest way to obtain efficient protection in these respects is to enclose all high tension conductors within a strong covering so constructed that access to them while they are alive is rendered impossible. At the same time the insulators supporting, and the insulators covering the conductors, should also be enclosed in such a way that the only exposed parts of the switchgear are metal casings at earth potential.

Armoured Switchgear.

To meet the foregoing requirements a type of apparatus has been evolved which, for the sake of convenience, may be referred to as "Armoured" Switchgear. The general appearance of a panel is shown on Fig. 16, and a cross section of a panel containing bus-bar, switch, transformers, and relays (*i.e.*, the aforesaid irreducible minimum for an automatic panel) is shown on Fig. 17. The bus-bars are enclosed in a separate iron chamber made up in segments with band joints between each panel. The bus-bars themselves and the joints are immersed in insulating compound.† The current transformers are enclosed in a separate chamber for each panel, and, like the bus-bars, are immersed in compound. These two chambers are supported on standards which form the framework of the gear.

The oil switch is of the draw-out type. A section through the switch when drawn-out is shown on Fig. 18. A pair of doors which are normally tucked away between the bus-bar and transformer chambers, automatically follow the switch carriage out and close over the orifices which contain the plug connections to the bus-bars and transformers respectively. (The doors are shown at A, Fig. 18.) Incidentally, this illustration shows an instrument in position and one arrangement adopted when the use of a potential transformer has been essential.

Figs. 19 and 20 show the front and back views respectively of switchgears constructed on the armoured principle, but operated from the usual type of slate panel carrying a number of instruments, relays, and synchronising apparatus. Duplicate bus-bars are shown at A and B in the last illustration.

Conclusion.

It is a fitting conclusion to consider briefly how the apparatus mentioned in this paper complies with the essential conditions which have been enumerated at the onset, and how they differ from other apparatus in general use.

Reliability in the automatic isolation of a faulty section without disturbance to the sound sections has been obtained by the use of the balance system of protection, whilst older systems of protection have been uncertain in their action, failing more especially in the discriminating factor.

Freedom from shocks and burns has been obtained by the avoidance of exposed bare conductors.

Freedom from breakdown has been secured by using insulating compound as a filling medium between conductors throughout, this taking the place of air insulation in many other types.

The enclosure of all conductors and insulators carries with it a reduction in the maintenance work, including cleaning, inspecting, testing, etc., and also eliminates the risk of the insulation being lowered by conducting fumes, moisture, etc.

Robustness of construction is obtained by the armouring, and switchgear so constructed compares with other types of apparatus just as an armoured cable in rough service would compare with a non-armoured one.

The routine maintenance of switchgear has been confined to the switch contacts operating mechanism, and the protective relays, and whereas the inspection of apparatus on some switchgear designs involves great risks, the interlocking arrangements described have furnished a means for effecting this work in safety.

The systems of balance protection described are not intended to cover the present production of any particular manufacturer, it being understood that several firms manufacture this apparatus.

The author is indebted to Mr. F. V. Hunter (of Messrs. Merz & McLellan) for his assistance in the preparation of this paper, and also to Mr. Charles H. Merz and Mr. Bernard Price, much of this paper being the outcome of development work on their patents.

† Highfield Patent No. 20968 04.

DISCUSSION.

Mr. Wedmore emphasised the importance of considering the possible result of breakdown as a criterion in switchgear design.

He distinguished between generating station and sub-station switchgear, pointing out that a fault in the latter would be cleared from the generating station end and thus could not cause such extensive damage, whilst a serious fault in a generating station switchboard might result in the complete destruction of the switchgear, which, being the most vital part in the system, would produce chaos. There was consequently a serious risk attached to the concentration of switchgear in a generating station, and he considered that the universal practice of adopting the type of board, facetiously described as the warehouse type, for large generating stations was fully justified.

In sub-stations and small stations where concentration of switchgear could be justified and where compactness and low cost were primary considerations, Mr. Wedmore was of opinion that the compounding system was neither necessary nor ideal. Equally compact truck type switchboards were obtainable in which every part was more accessible than in the compounded type. Taking an example of both types, freedom from breakdown was determined by the skill and knowledge which entered into the construction of each individual device used, and did not depend upon the presence or absence of compound. Mr. Wedmore maintained this proposition by a detailed criticism of the design illustrated and stated that the cleaning bogey could be dealt with by the employment of a dust-proof construction. In the event of a bad fault the cellular type could be likened to an open barrel of gunpowder, but the compounded type to a bomb.

The man attending a board of the type illustrated in Fig. 18 would have to "face the music" if anything went wrong.

There was not the same certainty attached to the factor of safety obtained in compound that there was with air insulation. Every year witnessed the failure of a certain number of most carefully compounded joints.

With an instrument transformer of the type illustrated, in the event of the secondary becoming open circuited, the core, and consequently the insulation, would become heated, and possibly seriously reduce the factor of safety. On a large plant a failure at this point would result in explosion.

Turning to the subject of discriminating apparatus, Mr. Wedmore explained that in determining whether current was forward or reverse, some standard was necessary. In the early days the only known standard was potential and reverse relays were made in which the phase relations of the current and potential were compared. He was the first to make a reverse current relay operative on current only, and his colleague, Mr. Clinker, the first to suggest the employment of pilot wires taking a sample of current from the generating station end of a feeder to the sub-station end for discriminating purposes.

About the same time the very practical and complete solution of the problem universally known as the Merz Price system was produced, and only those closely associated with the design of this class of apparatus quite fully appreciated the great skill and energy with which this scheme had been developed.

Mr. Wedmore considered that there was no better system than the Merz Price system known in the art, and that there was no other reliable system in use for the protection of interconnectors and single ring mains.

At the same time, on account of the cost of Merz Price plant it had been necessary to develop other types, and the relays, etc., obtainable in the present day were far superior to those known at the time the Merz Price scheme was adopted; such apparatus and devices were in extensive use and giving complete satisfaction. Reverse current relays could now be obtained which would operate with great rapidity at very low voltages and the arrangement could be made surge-proof by the adoption of suitable connections.

As an example of simple devices of the kind, Mr. Wedmore instanced the case of a group of parallel feeders or interconnectors of equal resistance, self-induction and capacity; in such a case the current in any one feeder could be used as a standard for comparison with that in any other, the feeders being paired for the purpose, and direct-acting trip coils connected so as to instantaneously disconnect a faulty couple on a small fault occurring. This arrangement was surge-proof, and no pilot wires were required. The system is shown diagrammatically in Fig. A, the diagram showing only one phase for the sake of simplicity.

In a more common case of two parallel feeders the service could be met by the employment of reverse current relays of modern design, the arrangement being made surge-proof by the combination of the balancing system above described. The balancing system ensured that there would be no current for tripping purposes except in the event of a fault occurring on either feeder. The reverse relays were employed to normally short-circuit the trip coils, and in the event of a fault occurring only the corresponding reverse current relay would operate, thus rendering the trip coil effective only on the faulty feeder. About 200 of the reverse current relays referred to were in service protecting generators and feeders and had hitherto met all normal and abnormal conditions of service in an entirely

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satisfactory manner. The apparatus had been very severely tested and severe faults had been negotiated in service conditions. The above is illustrated below in Fig. B.

It was held that the ring main system and employment of single feeders should be generally adopted on the score of economy of cables. Mr. Wedmore, however, met with a large number of instances in practice where it was found that the adoption of the ring main system was not justified. Taking, for example, a typical case of a centrally-situated generating station surrounded by three, four, or even five sub-stations, it would be found as a rule that the amount of cable required to furnish a duplicate supply direct from the generating station to each sub-station was materially less than would be required if single cables were so employed and each

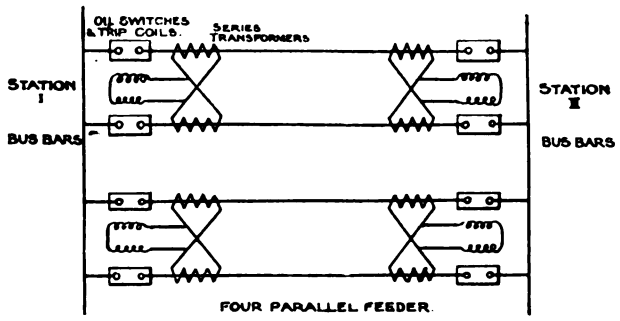

FIG. A.—FOUR PARALLEL FEEDERS.

sub-station were inter-connected to its neighbour. If an extension were made on such a system to a remote point the employment of two cables following the same route would still generally be the most economical arrangement.

Again, in the case of distributing power over a small area where the location of distributing points could not be foreseen, it would often be found more economical to employ a direct duplicate supply system, especially having regard to the cost of obtaining way-leave and of opening up two ways instead of one. The most economical route was often one which could not possibly be adopted.

The employment of duplicate parallel feeders, which was a practice very extensively adopted and likely to be continued, not only left the way open for the employment of simple protective systems of the kind Mr. Wedmore had referred to, but where first cost was a primary consideration, on account of the small load obtainable, there was an alternative method of distribution which deserved to be better known. Mr. Wedmore referred to the system of dividing the cable system into two portions, A and B, coupled normally only at the generating station, switches being provided on each consumer's premises, and distributing centre arranged for taking the supply only from one

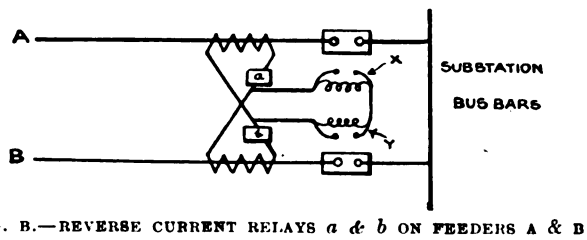

FIG. B.—REVERSE CURRENT RELAYS *a* & *b* ON FEEDERS A & B NORMALLY SHORT CIRCUIT THE TRIP COILS AT POINTS X & Y RESPECTIVELY.

system at a time. Customers were normally suitably distributed between the two supply systems. Local ring connections might be arranged to pick up unimportant customers on such a system. Without the employment of expensive switchgear and selected apparatus it was possible to obtain a high degree of reliability of supply. In the event of the supply failing on one feeder the customers of that feeder would switch over to the alternative supply. In the case of this system it would be seen that feeders would be mostly open ended and could thus be protected by the balanced core system at the generating station end. This system with an earthed neutral enabled individual faulty feeders to be disconnected on a fraction of normal load current, and fault currents could be limited by the employment of a suitable high resistance in the earth connection so that general disturbances to the system consequent on the occurrence of faults to earth could be eliminated. It was often not recognised that a heavy fault on one phase of an earthed system could cause the disconnection of individual induction motors and other apparatus at various remote parts of the system owing to disturbance of balance and magnitude of voltage at the generating station.

Mr. WOOD: Referring to the charging current of a static transformer which, according to the author was equivalent on the protective gear to a fault condition, and noting that fuses were shown on Fig. 5 across the relays, inquired whether similar precautions were necessary to guard against tripping feeder switches owing to capacity current in the main cable.

Mr. HUNTER: Mr. Clothier is one of those eminent designers to whom we all look for guidance in switchgear matters, and I think we are very fortunate in having him working in the North. We are more fortunate in having this paper read in Newcastle, giving the results of his experience in switchgear problems during the last five years. I think the Local Section should be proud of the fact that he has chosen to read his paper here. Mr. Clothier has periodically written papers on "Switchgear," and I think this paper represents a considerable advance in switchgear design since his last one. There is only one defect which I may, perhaps, mention in connection with Mr. Clothier's papers, they do not lend themselves readily to criticism; one can only differ from him, if at all, in fundamental principles. His design is a logical development of apparatus to meet certain essential requirements with a rigid elimination of anything in the nature of unnecessary ingenuities. On reading the paper carefully I think every one will find several facts brought out which give an entirely new aspect to the switchgear problem. Many of these points I have not seen mentioned previously before a Society such as this or in the technical press. I wish to refer to one particularly, namely, the failure of a switch due to the gases and volatilised metal escaping from the switch tank (when the switch opens on a heavy "short") and producing a "short" circuit across the terminals on the outside of the switch. This is, of course, equivalent to a "short" on the bus-bars, and is a very serious matter. In fact, as Mr. Clothier says, it is the most serious fault that could possibly occur. Until the development of the armoured switchgear there was no switchgear which completely guarded against it. Mr. Wedmore mentioned that the armoured switchgear is not suitable for power station work, and if one qualifies his remark by "large power stations," I think he is correct. For very large power stations a special design would be necessary, and probably the demand is so small as not to justify the development. I have no doubt, however, that the armoured principle applied to heavy power station switchgear would be an improvement on existing standards. Mr. Clothier makes a great point of the balanced protective gear, and there is no doubt that, from the point of view of a switchgear designer, it is an extremely good thing, as it enables him to simplify his switchgear. On the other hand, from an operation point of view, its maintenance is a great responsibility, as a failure to operate in the event of a fault would have serious consequences. And, although experience shows that when properly designed it is extremely unlikely to fail, the bare possibility is sufficient to make frequent inspection and testing necessary. This is partly due to the fact that were the apparatus in an unsatisfactory condition it would not be noticeable except by inspection and testing. However, at present there is no alternative to it, and it saves anything from 20% to 40% of the cost of a large mains distribution system when compared with any other arrangement of protective devices. You will notice that the diagram Mr. Wedmore shows is useless for single-feeders and to supply current over a large area single-feeders are essential if the supply is to be given on a commercial basis. As Mr. Clothier aptly puts it in his paper, "For the same service one cable is cheaper than two."

Mr. MOUNTAIN said he was not prepared to say very much, but it seemed to him that if you have everything in front of you that is likely to go wrong, it is more satisfactory than the gear which is out of sight. In regard to the "Merz-Price" system, he had had this up with Mr. Clothier before, and the only objection that he could see to its adoption in colliery work is that it involves the use of a fourth wire. If we could get the same simplicity and the same satisfactory results from a system without the pilot wire, he would be in favour of it for use in collieries. He had seen some of the protective systems which the author developed, and he thought protective systems were very useful provided they were not overdone. He would not like to see the system so nervously constructed that if you touch something accidentally, the supply might collapse. If a pump breaks down in bye we must keep it going even if it means the colliery engineer standing by all the time.

He said that he did not approve of the use of so much slate, and was glad to see from the author's designs that much of this material was avoided. He said in the early days they used to use wood, which was much worse, and he was one of the first to introduce slate, and he related the circumstances under which the idea of the use of slate had occurred to him. He was sure the Institution owed Mr. Clothier a great deal for his practical paper.

Dr. THORNTON said that it was from the physical side of the question which interested him, and he asked whether petroleum emulsion had ever been used as a switch oil. He thought that one of the difficulties of switch oil was the carbonisation of the oil, and petroleum emulsion might effect an improvement in this respect.

Mr. C. S. VESEY-BROWN said he had not much to say about them, as he had only been able to read it as Mr. Clothier read it. Switchgear had always interested him. He said the oil which used to be used was of a resinous character, but it used to carbonise too quickly.

Regarding the armoured switchgear, he thought it was the right thing to enclose the bus-bars and all live conductors, as he would prefer to know that he could touch the switchgear rather than that he must only look at it. He always felt that he would like to touch it just to see if it really was alive or not. He thought the design of switchgear had sometimes been carried to that

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degree that it could talk, and that automatic gear was sometimes made to come out before it ought to, not because it wanted to, but because the designer made it so. In the author's arrangements, however, it was made as simple as one could get it. It was important to standardise and so enable an ordinary workman to have some idea of what he is doing as he goes from one district to another, which would not be so if different systems were used.

Mr. ANDERSON said that when ironclad switchgear was first introduced into the Newcastle Electric Supply Company's system, he imagined all sorts of trouble, but he is now convinced that it is the safest piece of apparatus they have got on the system, and the sooner the other people find this out the better. The only difficulty which he experienced was to determine where to put in the switchgear and where not to put it in. The question was to what load is it safe to use high tension fuses. He thought the safe limit was somewhere about 300 kw. Referring to protection of static transformers, he suggested that below a certain size the installation of automatic switches was wasting money. He thought for small sizes it would be a great thing to combine high tension ironclad gear with fuses. With regard to the "Merz-Price" gear, he thought one realised its usefulness much better when one looks at the diagram of connections of the control board at the power station at Carville on which the positions of the various switches are clearly marked. When a switch is out you may be sure that repairs are going on or that that part of the system is not protected by the "Merz-Price" gear. The latter cases indicated a loss in that only half the copper was being used. He said that he had no record of a single instance where the armoured switchgear had caused the discontinuity of supply to a single consumer.

Mr. HUNT (Ferranti, Ltd.): In dealing with the question of balance protection you could deal with this actually as a magnetic balance, and a device of that kind has been worked out by Mr. Field, which balances the magnetic effect of the three cores of the cable and thereby obtains the same result. The apparatus can be made sufficiently sensitive for tripping out any automatic switch. To get an increased sensitiveness it is only a matter of increasing the amount of iron.

Dr. THORNTON touched incidentally on the fact that an automatic switch takes time to operate, however completely the short circuit might be and whatever fault might occur. The forces at work to operate the switch are generally spring or gravitation. These forces are comparatively limited, and the mass of the switch parts take quite an appreciable time to get into motion, however prompt the relay may be in carrying out its work.

Mr. VERNIER, referring to the high tension network in this district, a portion of which is shown on Fig. 1, asked Mr. Wedmore what he would do with it in the matter of protection.

Mr. WEDMORE: I would "Merz-Price" the whole lot.

Mr. VERNIER referred to the advantage of laying cables along duplicate routes, and said if you take a pair of cables or a dozen cables along the same route anything might happen which would put the whole lot out of commission, whereas by taking a cable along a duplicate route nothing of this kind is likely to occur. He referred to the automatic protection of overhead lines, and said that the difficulty was that a fallen line might not allow sufficient fault current to earth to trip the relays, and suggested a modification to one of the protective systems involving the addition of a fourth core in the pilot and connecting the transformers in star at each end with their neutral points joined to the extra pilot wire.

In regard to the rapidity of action, he did not know how long it took to operate the switch, and he referred to practical experiences where the gear had cleared faults to the supply company's network. He had found that it operated with such great rapidity of action as to prevent any shocks on the power station, and it also prevented the throwing out of step of any synchronous machines that might be running on the system at the time.

Mr. G. L. PORTER said that with the ordinary design of transformer the secondary potential rises with the primary current, and as the capacity effect increases at the same time the current tending to trip the relays is not strictly in proportion to the primary current. The gear requires a minimum fault current to trip and the difference between the product on the primary induced by its minimum fault current and the maximum current due to capacity with straight through excess loads is the working margin. One gets the maximum tripping current due to a heavy, fault close to a power station and the minimum tripping current due to a small fault remote from the power station, but in the latter case there is, of course, a capacity current acting as a spurious fault current and the difference between these two quantities is the working margin. With the Supply Company's present arrangement, however, the working margin is much larger than is necessary.

Coming to the question of overhead lines dropping on to dry grass, or, for instance, a hayrick, it is difficult to get gear with enough margin to trip under these conditions and still not trip on account of capacity currents. One remedy is to use current transformers having a falling characteristic, and another plan is to use inductance coils in shunt with the relays.

Current balancing for transformer protection undoubtedly has a very large field, but in sub-stations equipped with one transformer only, there is no need for apparatus with the rapidity of action attained by the Merz-Price system.

In connection with transformers it is essential to have a time limit device on the main switches on account of the rush of magnetising current which occurs when switching in, and which may attain two or three times full load value, in the case of a sub-station with two transformers it is better that these should work independently as, in the event of a heavy fault on the low tension side when they are working on common bus-bars, with a station like Carville behind them, both transformers would probably be wrecked and there would not be a standby.

The Merz-Price system should undoubtedly be adopted where two or more transformers are working together. For extensive schemes such as those on the power companies in this district no time limit overload relay will meet all the conditions which may arise as, for instance, in the event of a serious fault on the system, it is essential that the overload relays should enable Carville to hang on to the load until it had cleared the fault.

With overload relays the best that can be done is to mount two relays on a panel, one with a large instantaneous overload setting, and the other with a smaller time limit setting.

With regard to generator protection, he would point out that the winding of generators was such that generator faults were not by any means always a fault to earth, and consequently faults between phases had to be guarded against. He suggested that an arrangement consisting of one current transformer on each phase and one on the neutral and connected in series with the relay would efficiently protect a generator from any fault.

Mr. CLOTHIER, in reply, said that he considered it a great compliment for Mr. Wedmore to travel so far in order to take part in this discussion.

He admitted Mr. Wedmore's authority on the subject, and said that he always took a most lively interest in any publication issued by Mr. Wedmore on the subject of switchgear and protective apparatus.

Replying to Mr. Wedmore's criticisms, he said I am very sorry that he does not like the armoured type of switchgear in which all conductors are run in solid with compound, and I cannot help thinking that he is making a mistake in this, and only hope that some day he may come to see the matter in a different light. It seems to me only natural to enclose all conductors in this way on switchgear because wherever possible it is the practice to run in everything solid or immerse conductors in oil; for instance, cables are run in solid as well as the joints; current transformers and potential transformers are immersed in oil or compound wherever possible and the covering up of all conductors in an oil-filled tank is almost a universal practice for the insulation of static transformers.

I am pleased to hear, however, that he agrees with the principle adopted of drawing out the switches, and note that he would add to his carriage other apparatus. The gear he proposes would in this respect resemble the A. E. G. Wagon type which I may say was carefully studied prior to the design of the gear discussed in my paper.

He refers to a bomb, but I must say that I think that the enclosure of H.T. conductors within a cast-iron chamber with air insulation much more resembles a bomb than a chamber filled with compound, because the former case on the event of an explosion occasioned by a short circuit occurring the castings would fly in all directions, whereas in the other case, the compound sticks to the casting and would prevent the pieces from flying.

Mr. Wedmore has suggested the failure in the compound enclosed chambers and has asked for statistics. I may say that the gear has been in course of construction and use for over 5 years, and about 500 panels are in commission. Some of the other speakers have saved me the necessity of enlarging upon the results.

I am not sure of the detailed construction of the gear preferred by Mr. Wedmore; it would probably be constructed with wrought iron or steel and not cast-iron.

Mr. WEDMORE: It includes cast-iron.

Mr. CLOTHIER: I think you would be well advised to have no cast-iron in the E.H.T. air insulated chambers, as the iron may crack and fly about.

Referring to Mr. Wedmore's diagram of protection involving duplicate feeders, I think under some circumstances it would be a useful one and it is a clever proposal, but everyone agrees that it would often be difficult and extravagant to lay out the net-work in the particular way necessary to accommodate this type of protection. I was glad to hear that Mr. Wedmore admits that on an economically laid-out system, such as we have in this district, nothing at present is known but the balanced system of protection with pilots to comply with the requirements.

At first sight one might expect to effect a saving by eliminating the pilot wire, but it would be found in most cases in practice that the saving effected by using one cable instead of two more than counteracts the costs of the pilot.

With regard to Mr. Wedmore's preference for the cellular type of switchgear for large power stations, I hope the day is not far distant when even for power station work some switchgear construction will be adopted which includes the complete enclosure of all conductors in compound filled metal casings, as we cannot close our eyes to the fact that there are many

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instances on record where power stations have been entirely shut down owing to faults on one part of a cellular switchgear travelling into other chambers and putting the whole switchgear out of commission.

Mr. Mountain refers to earthing the neutral and protective gear in mines, the core balance or leakage protection shown on Figs. 8, 9, and 10 has been devised with the requirements in mines particularly in view, but they depend for their instantaneous action upon the neutral of the systems being earthed. It is significant to note from a sample of cable on the table that a fault can be cleared so quickly by a switch with an instantaneous release that there is only a small hole in the insulation and that the outer dielectic has not been pierced. With an armoured cable an instantaneous release bids fair to clear a fault without any risk of flashing external to the cable.

Dr. Thornton has referred to the speed of operation. Experiments made some time ago from which it was estimated that the switch mechanism required between one-tenth and one-twentieth of a second to open circuit after the contact was made on the relay. This is only a rough guess, and some osciligraph records to obtain more accurate measurement of the time interval would be of value. Improvements in the future may be well directed towards increasing the speed of operation. It seems to me that the ideal switch would be one that clears a fault in the fraction of a period, but at the same time actually opening the circuit when the current wave form is at zero.

CONTINUATION OF REPLY TO DISCUSSION.

In reply to Mr. Wood: Current on switching in a cable due to capacity is not nearly so heavy as that which occurs on switching in an open-circuited transformer. The latter may be two or three times the full load current and, therefore, would trip the protective gear, whereas the current on switching in a cable is of a much lower value than that required to trip out the relays.

In further reply to Dr. Thornton, I have not any experience in the use of petroleum emulsion as a switch oil. There are several good qualities of oil now procurable and used extensively for switches and transformers. The average particulars of switch oils are as follows:—

Average boiling point	..	360° C.
Average flash point	..	175° C.
Dielectric strength	..	13,000–20,000 volts to arc across 1 in.

Special consideration is given to oil which will not absorb moisture as the insulation of the oil is materially reduced by the presence of any moisture.

The condition of oil at low temperatures has been taken into account, and other things being equal, preference is given to oil which will remain liquid at 15° F. It is also important to observe that there is no reaction with copper or other metal. Dr. Thornton referred to carbonisation of the oil and preference should certainly be given to an oil which gives off the minimum amount of free carbon when exposed to an arc. Such oil would obviously cheapen maintenance as it would call for less frequent renewals of the oil, particularly in a switch which is frequently operated, but the point is not so important as one would suppose at first sight, as it has been proved by test that, even though the oil be black with free carbon, its insulating properties are not necessarily seriously impaired.

Off-hand I should expect to find that petroleum emulsion has a lower flash point than the average switch oil in common use, and that it would behave well at low temperatures.

When considering sub-station switchgear, it is necessary to take into account the possibility of a switch failing to operate if the oil in its tank has become too solid.

Mr. Brown refers to the touching of bare conductors and apparatus talking. A bare high tension conductor under normal conditions looks so harmless that it would be a good idea if it could be made to speak a message of warning to anyone near to it. I have often thought that it might be possible to improve the safety to life factor if some visual indication could be given when a conductor is alive. Electrostatic devices have been used for this purpose, but what is more necessary is some indication which would be spread over the conductors. The hair on the back of a cat when its temper is roused is the nearest analogy I can think of.

Mr. Anderson suggests that the complication of switches is unnecessary for static transformers under a certain capacity. Oil switch fuses have been designed for such purposes, and I agree with Mr. Anderson that some more economical arrangement than that shown on the illustrations in the paper should be used for the protection of small static transformers on some systems, but I do not think it would be advisable on a large system such as we have in this district, as the circuit breaking capacity of the protective apparatus is controlled, not by the size of the static transformer which it protects, but by the amount of current which will pass into a fault occuring on the apparatus, and this in turn depends to a great extent upon the aggregate capacity of the generating plant which is running on a fault. And so the breaking capacity of switching apparatus should be just as efficient for a 100 kw. static transformer as for a 1,000 kw. static transformer.

Mr. Hunt has referred to a magnetic balance system. On referring to the paper he will see Fig. 8, is a diagram of connections of a protective system similar to that to which he has referred. Mr. M. B. Field is an excellent authority on such subjects, and in this matter he appears to have worked on similar lines to Mr. Price. Patents have been granted to both of these engineers. That of Mr. Price was applied for in December 1908, whereas that of Mr. Field was applied for in May, 1909.

Mr. Vernier has referred to protection against falling overhead lines in such cases where the line may fall on to a field of corn where the fault current would be exceedingly small.

On at least one system bare pilot wires are used, and it is most likely that a conductor in falling would make contact with one of these. I admit that it is rather a drastic step to thus put the high tension conductor in contact with the pilot wire, but it is one which would certainly open the relays, and protection against damaging the insulation on the secondary system is provided by the installation of spark gaps. I mention this as an actual instance rather than as a system to be advocated.

In other instances lead covered pilot wires are slung on a steel catenary and, in the event of a live line falling, it is most likely to strike the catenary and, provided this is well earthed, the fault current at the moment of impact should be sufficient to trip the relays.

Mr. Porter has referred to the capacity current in the pilot cable. This capacity current tends to create in the pilot circuit an out-of-balance equivalent in its effect to a fault condition. On this account it has been found necessary to keep the voltage of the relay circuit as low as possible and the current required to trip the relay as large as possible.

On some transformers the effect of capacity on the pilot is reduced by working with the saturation point in the iron at a lower primary current than on the transformers which are used on the 6,000 volt systems in this district where they have a straight line characteristic up to 5,000–6,000 amperes.

Interference with the proper working of the feeder balance protective gear by capacity current is not so likely as would be expected on first consideration. The pilot capacity current is not a serious item on short cables. It is only in the case of exceptionally long cables that the interference is felt, and it must be borne in mind, when the cable is a long one, the amount of straight through fault current which can pass through is limited by the resistance of the cable.

A further step towards limiting this effect is to make the relays which are near the generating plant with a higher fault setting than those more remote. In this district, for instance, I believe the relays near to the generating plant are set for a 300 to 800 ampere single-phase fault to earth, whereas those more remote are set for 200 amperes under similar fault conditions.

I understand Mr. Porter's suggestion in regard to generator protection is as sketched below, and this seems an excellent idea. Of course, it will only work with faults to earth, but, as he remarks, a fault on a generator armature is most likely to be of this nature, and if not it would very rapidly develop into a fault to earth. The use of this system is a distinct advantage as an addition to an existing generator, owing to the fact that it would not be necessary to disturb the armature winding, as must be done with the other system in order to insert the current transformers at the neutral point.

Mr. Porter suggests, where only one static transformer is used in a sub-station, that the balance protective gear is not necessary. In this I agree to a certain extent, *i.e.*, it is quite unnecessary for the protection of the transformer itself, but it is possible that an ordinary overload system of protection with the same degree of sensitiveness as the balance system of protection is likely to trip out owing to a fault on a branch of the consumer's premises. Under this consideration it may be advisable to retain the balance protective gear even on a single transformer, in order to provide protection which will hold in against a straight through excess load.

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LIGHTING INSTALLATIONS.

Many forces have been at work bringing about a general cheapening of electricity for illuminating and other domestic purposes. Inventors and manufacturers have been busy improving appliances from prime movers and generators to the controller switch and the metallic filament lamp. Central station engineers have been closely studying methods of generation and distribution. Lowering the cost of production has been the result, which has induced increased demand, and with the bigger bulk generation fresh economies have come about. Thus it is that current is now available not only for the wealthy and smaller incomed middle classes, but for the artisan and cottager generally. It is certainly one of the most interesting and encouraging signs of the times to see how the use of electricity for lighting in low rented tenements and small cottages is spreading in all parts of the country. While this is, no doubt, primarily due to the lowering of the price of current combined with the increased efficiency of lamps, the movement has also been very greatly accelerated by the vast improvement and simplification in all that appertains to the house wiring side of installation. Wiring still is one of the big difficulties in the way of general adoption of electricity, but much has been done to minimise the cost involved. Moreover, the various systems typified by the employment of stamped out metal casings for the wire, while bringing about economy in materials, has also lessened the amount of expert labour needed on the job of wiring large or small premises. All this has brought electricity within the reach of an ever-widening circle, but before the full benefit of this can be felt it will be necessary to induce contractors and dealers all over the country to realise the splendid possibilities these changes have opened up. Various methods have been attempted to quicken the process of introducing the new state of affairs to those most directly interested, the householders. In some places companies have

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been formed to undertake the duty of paying for wiring carried out by contractors and collecting the amount from consumers in deferred payments. In other instances this work has been carried out, or attempted, by municipalities, causing some friction with local traders. Happily, however, municipal electrical engineers or their business managers are conferring with the contractors, so that the chances of a sensible alliance are very good. Looking at the matter from a purely practical point of view, no doubt it would be to everyone's advantage if the bulk, if not the whole, of house installation work was undertaken by contractors. But before this comes about a better organisation is needed among dealers. In most large towns thoroughly competent contractors, who keep in touch with the latest developments of the electrical industry, are to be found. But it is by no means always so in the smaller towns and suburbs. Too many dealers are content with old-fashioned methods and fittings, and through lack of closer touch with manufacturers or wholesale dealers, are not in a position to place before inquiring or potential customers the up-to-date advantages of electricity. Progress is, of course, being made, but we ought to see greater interest and enterprise among contractors and those dealers who are professedly anxious to act as go-betweens the manufacturers and purchasers.

TECHNICAL PROBLEMS, WITH SOLUTIONS BY PRACTICAL MEN.

RULES.

Under the above heading we insert questions of a practical character relating to power stations, electrical railways, and tramways, mining installations, electric power in workshops, electro-metallurgical plant, and electrical engineering work generally.

QUESTIONS.—For each suitable question we offer one shilling. Questions of a practical character stand a better chance of acceptance than those of a theoretical nature. Questions may be sent in at any time.

ANSWERS.—A fee of 10s. will be paid for the best answer, and 5s. for every other published. Replies should reach the office within 14 days of the appearance of the questions.

ANSWERS.

Question No. 1237.—Describe some ships' electrical steering gears that are in use, such as the "U. E. G." and Pfalischer systems, giving both electrical and mechanical details. Are there any systems where purely electromagnetic reversing clutches in combination with a continuously running motor are used? If so, what is the best clutch to use? and if not, what faults do such clutches develop?

ELECTRIC SHUNTING LOCOMOTIVES.

Answer to Question No. 1237 (*awarded* 10s.).—The great advantage of electric over steam locomotives for intermittent and short distance working undoubtedly lies in the high acceleration and quick working possible with the former. At first sight it might appear that this advantage would be particularly valuable in shunting yards, but it must be remembered that, though firing difficulties, waste steam while waiting about, and shortage of steam on exceptionally heavy working, are avoided by the use of electric shunting locomotives, the subdivision of drive, which makes the rapid acceleration of electric passenger trains feasible, is here impossible. It follows that an electric shunting locomotive will have to be as heavy as the equivalent steam engine in order to attain a certain acceleration without slipping of the "drivers," and, to reach the higher acceleration which its greater reserve of power enables, it will have to be correspondingly heavier to secure sufficient cohesion.

The quiet and clean working of electric locomotives is particularly advantageous in town and residential districts, but the frequent starting and stopping and the low average speed required, detract from the usual advantages of electric over steam locomotives. The maze of points and crossings in a shunting yard or goods terminus complicate an electric equipment, and make it very costly to instal. Live rails would, of course, be dangerous to life in a shunting yard, and overhead supply is essential on this ground alone: fortunately the latter system is preferable in all respects for small areas, particularly where many crossings have to be provided for.

The general opinion in England seems to be that electric locomotives are not specially suitable for goods yard service, but in America they are in considerable favour (notably in mine yards, etc.). Special locomotives have been built for this service, and, though the advantages of electric traction are not realised to the same extent as in passenger haulage, the high draw-bar pull, the great overload capacity, and the low maintenance, cleaning and inspection charges have repeatedly proved a sufficient justification for the capital outlay involved. Assuming, therefore, that electrical operation has been decided upon, it becomes necessary to choose between D.C. and A.C. and between single-phase and polyphase supply. It may at once be stated that the ultimate choice lies between direct and single-phase current, and that, in the vast majority of cases, the D.C. equipment is far preferable, and for the following reasons:—

The great advantage of alternating current working on railways lies in the efficient transmission of power over considerable distances without the necessity for rotary machinery in sub-stations: these considerations—of primary importance in main line working, and of great importance on suburban lines—hardly count at all in the present case (especially since cranes and lighting have to be fed from the same supply).

If the railway company generate their own power for the shunting yard, as is quite likely to be the case, a D.C. plant will be considerably cheaper in all the capacities (kw.) likely to be required. Of course, were the yard worked in conjunction with an electrically operated main line other conditions would rule than are set forth in this and other paragraphs. Such a supposition is hardly of practical importance as yet in this country: were the main line equipment single-phase (as would probably be the case) the shunting yard might be operated from the main supply, though, even then, D.C. working from a rotary converter station would show considerable advantages.

Power for power, D.C. motors are smaller, lighter and cheaper than single-phase machines, which form their greatest rivals in traction service. The higher hysteresis and eddy losses necessarily make any A.C. motor less efficient than the equivalent continuous current machine, while the laminated field frame of the former is a considerable item of expense. Direct current motors avoid much of the auxiliary equipment inseparable from A.C. traction motors, are less liable to breakdown, and have, on the whole, a better "traction characteristic" than their rivals. Nevertheless, the speed load curve of modern single-phase commutating motors is not greatly inferior to that of D.C. machines (from the traction standpoint), while the former have the great advantage of efficient running on every notch of their controllers—voltage regulation being by auto-transformer instead of by series resistance. This advantage is particularly great in shunting yards since so great a percentage of the total duty is covered by "starting" and "intermediate" speeds. Though the losses on starting are low in single-phase motors, the commutator sparking is liable to be very bad; the friction of the shorted brushes of certain types conduces to heating and other commutator troubles, and, in any case, the commutator voltage which may rise to 500–600 volts on D.C. motors is limited to about 250 volts on corresponding A.C. machines (thus often necessitating two of the latter in series where a single D.C. motor could be employed). These disadvantages, more than compensated by the above advantages on long distance main lines, are of great importance in the present case, and, when taken in conjunction with the higher overload capacity, the greater speed regulation and the better starting on heavy loads (apart from the efficiency consideration) of D.C. traction

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motors, practically determine the installation of the latter for all such duties as railway shunting and sorting.

Three-phase motors are far inferior to single-phase machines, in that their speed is very discontinuously regulable, and that only by complex and unsatisfactory means. No three-phase motor has starting or running characteristics suitable for heavy, intermittent, slow-speed traction; the perfect maintenance of three-phase motors is a matter of great importance and difficulty (in traction service) and, finally, a three-phase power line is more costly than the equivalent single-phase transmission.

Considering the relative suitability of D.C. and single-phase current for auxiliary motors and yard lighting, it will be found that for:—

Cranes, etc.—The advantages of D.C. motors over single and polyphase motors are much as outlined above. A greater choice of running speeds is available to the former and the load characteristic and working efficiency of the D.C. type are undoubtedly superior for miscellaneous power loads. Once again, the area of distribution is not sufficiently great to seriously involve the question of efficiency of transmission. Equally low tension supply is requisite whichever system be adopted (both for safety and to enable motors and lamps to be supplied from any part of the transmission route).

Lighting, etc.—The lighting of a goods yard (a most important factor in averting accidents) would certainly be by arcs in an electrically operated system, and it is only necessary to briefly reiterate the superiority of D.C. over A.C. arc lamps—particularly where the frequency of A.C. supply is as low (25 ~) as is desirable in traction service.

Summarising, therefore, we have that electric locomotives offer moderate, but still decided, advantages in shunting yards, goods termini, etc., and that, under all ordinary circumstances (and particularly where cranes and lighting are also fed from the same supply), D.C. working at 440–500 volts is advisable, this being a convenient pressure for the locomotive and miscellaneous motors and not inconveniently high for series-parallel art lighting. By the use of a three-wire D.C. distribution the supply of arc lamps and small motors is further facilitated.—"WREN."

ELECTRIC SMELTING OF IRON ORE.

Mr. E. F. Gray, H.B.M. Consul at Christiania, sends further particulars of the four principal undertakings in Norway interested in the electrical smelting of iron ore as follows:—

1. The Tinfos Paper Mills, near Notodden, in Telemarken. The process used by the company owning these mills is stated, on the one hand, to be the invention of Messrs. Blakstad, Holta & Company, of Skien, and on the other of an engineer named Bie Lorentzen. It is stated that experiments have been conducted since January last with such success that the directors of the company have now decided to erect modern works for electric smelting in connection with foundries and steel-works, employing up to 15,000 h.p. of energy from an electric power station now under construction at Hitterdal Lake, where quays and warehouses are also to be built; 5,000 h.p. are to be available by next summer, and the remainder by 1912.

Mr. O. H. Holta, of Skien, is stated to be the promoter of the undertaking, but communications regarding it should be addressed to the Tinfos Papirfabrik, Notodden, Norway.

2. The "Aktieselskabet Hardanger Elektriske Jern-og Staalverk," at Odda, Hardanger. Here is employed the Swedish Grönwall method, of which the patent for Norway is held by the Norwegian Electro Metal Company. The power for these works will be derived from the Tysse Falls. The estimates for the equipment of the works provide for two blast furnaces of 2,900 h.p. (one of these to be held in reserve), one steel furnace of 800 h.p., and rolling mills with a producing capacity of 6,800 tons of billets. These last, it is calculated, could be delivered at British ports at a price of about £8 per ton. If the works are extended to 14,000 h.p. the production is put at 25,840 tons of billets.

Communications regarding these works should be addressed to the A/S. Norsk Elektrometal, Christiania.

3. The "Nordenfjeldske Grubecompagni," Trondhjem. This company intends to employ the Lyons method used at Heroult, California. It is stated that the company intend next spring to erect, probably in the north of Norway, a furnace similar to the Heroult furnaces. Mr. Boholm, the manager of the company, is understood to have acquired considerable iron deposits and waterfalls in the Tromsö district, and it is thought that the furnace will be erected in that neighbourhood, if not near Trondhjem.

Communications regarding this company should be addressed to Hr. Ingeniör Boholm, Trondhjem.

4. The Ulefos Ironworks. Here the methods and patents of the Tinfos Paper Mills and of Mr. Bie Lorentzen, and also the patents of the Norwegian Electro Metal Company may be used. Satisfactory trials are said to have been made, and plant for a second electric smelting furnace has been ordered and is expected to be at work shortly. The electric furnace now being used is supplied with power from the Fehn Mines power station. In future, power is to be derived from a new reservoir near the works which is now approaching completion. The water power of the Eidsfos and the Vrangfos Falls has been acquired for the same purpose, and is being kept in reserve for future extensions of the works.

Communications regarding these works should be addressed to Hr. Kammerherre D. Cappelen, Ulefos Jeruverk, near Skien.

YEAR BOOKS, CALENDARS, ETC.

Messrs. A. & C. Black forward "Who's Who" for 1911 (10s. net), "The Englishwoman's Year Book" (2s. 6d. net) and "The Writer's Year Book" (1s. net). All three are carefully compiled and kept well up-to-date. "Who's Who" is a valuable mine of information, and we are glad to note that as the years roll by more attention is being given to men of science.

"Leicester Chamber of Commerce Year Book." Edited by L. V. Wykes (secretary of the Chamber). This book is in the second year of its issue. It is quite a model of a reference book for traders. A brief account is given of the local electricity supply for lighting and power purposes.

Among the 1911 souvenirs being issued by manufacturing firms to their customers we note the following:

Messrs. Callender's Cable and Construction Company, Ltd.'s, neat self-filling vulcanite fountain pens.

Messrs. Siemens Brothers & Company, Ltd., and Siemens Brothers Dynamo Works, Ltd.: Leatherette self-opening pocket diary, with memo pages and a collection of useful tables.

The Electric Construction Company, Ltd.: Leather vest pocket diary and notebook, with pockets and tables.

The Brush Electrical Engineering Company, Ltd.: Leather self-opening waistcoat pocket diary, with calendar and £1,000 accident insurance coupon.

Messrs. Bruce, Peebles & Company, Ltd.: Table blotting pad with calendar and side memo book.

The Union Electric Company, Ltd.: Tear-off calendar, showing an "Excello" arc lamp lighting up St. Paul's and London Bridge.

D.P. Battery Company, Ltd.: Tear-off calendar with three-colour print of Lathkill Dale, near the company's works.

Electricity Supply Publicity Committee: Small tear-off calendar, with a comical representation of the triumph of electricity over the humble tallow dip.

Messrs. Shand, Mason & Company: Fire-station calendar, with large cartoon by Mr. Alfred Pearse, representing Industry and Science aiding Valour.

WIRELESS EXPERIMENTS.

The Marconi Wireless Telegraph Company have erected a steel pole and wooden mast, together 210 ft. in height, close to their works at Chelmsford, to be used for experimental work with high-power currents.

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Electrical Progress at Home & Abroad.

Review by our Special Correspondents.

THE TYNESIDE.

("Electrical Engineer" Correspondent.)

NEWCASTLE-ON-TYNE.

On Wednesday, the 21st inst., the Newcastle Branch of the Association of Mining Electrical Engineers met at Armstrong College to further discuss the maintenance and supervision of electrical plant in collieries. Previous to this, however, Mr. Simpson, the local secretary, had to tender his resignation for reasons connected with his business, and Mr. H. W. Clothier was elected secretary, Mr. Robson being appointed assistant secretary. Representatives were also appointed for the General Council. The discussion chiefly revolved round the amount of supervision which should be given to running plant, and the best means of securing such supervision. Opinion appeared to be sharply divided between a close daily inspection of all parts and particular attention to strength of fuses, slinging of cables, etc., and a definite programme for the complete overhaul of each piece of apparatus at definite periods determined by previous experience in maintenance. The question of efficient earthing of a cable or switchboard during repairs also received considerable attention, various devices, such as links, isolating-and-earthing switches, etc., together with systems of locking and reporting, being described by the various members. So interesting did the discussion become that two technical questions which were down for answer had to be held over till the next meeting.

Electric Advertising in Theatres.

On Friday, the 23rd inst., I was favoured by an invitation by Messrs. Andrew Reid & Company, Ltd., of Newcastle, to inspect a system of electric advertising in theatres, which, so far at any rate as the North is concerned, is distinctly novel. Most music hall patrons will be more or less painfully aware of the advertisement theatre curtain which in some cases is a distinct eyesore for the quarter of an hour preceding the performance. The World's Advertising Company, Ltd., of which the above firm are the Northern concessionaires, have developed a system whereby in place of this curtain is a white screen, on which is thrown a series of high-class coloured advertisement pictures, each lasting about 20 seconds, the whole proceeding lasting about 15 minutes. It is repeated if opportunity serves at the interval. Each picture is shown several times during the evening, and constitutes an excellent advertisement. A yearly price is charged for the exhibition of each slide, magnified to a size of 36 feet by 24 feet, and prices are based either on exhibition at single halls or groups of, say, five or ten. In the present instance the Pavilion Theatre, Westgate-road, where the demonstration was held, is the pioneer in the North, while it is expected that group arrangements will be quickly made. This new application of electricity to advertising is singularly bold and effective in effect.

Coal Trade Developments.

The futility of carrying coal to Newcastle has become proverbial: the export by sea of coal from Northumberland and Durham has become phenomenal. Two schemes now in process of furtherance demonstrate this. The first is the projected building of huge new coal staithes at Cambois, to the west of the harbour of Blyth, to afford better shipping facilities for the coal obtained from the northern section of Northumberland. The North-Eastern Railway Company are going to promote a Parliamentary Bill for this and other objects in the newly-formed House of Commons early in the New Year. To meet the heavy demands created by the development of the west and north-west Durham coalfield work on the extensive staithes at West Dunston, to which reference has already been made in this column, will be pushed forward in the New Year by the North-Eastern Railway Company, who have given the contract for the construction to Messrs. Mitchell Bros., Ltd., of Glasgow. This development has interest to electrical engineers, as electric power has been already extensively used on existing staithes belonging to the company, and it may therefore be assumed that there is a case for its initial installation in new work.

THE MIDLANDS.

("Electrical Engineer" Correspondent.)

BIRMINGHAM.

The approaching transfer of the telephone has raised a number of questions in which a good deal of interest is being taken by property owners and traders in this district. The former class are particularly anxious with regard to the powers which the Government may exercise in regard to the flying of wires over private property and the planting of poles. In the past there have been occasional complaints of the crossing of private premises by wires without the permission of the owner or tenant having been obtained, and although the National Telephone Company's local representatives, when appealed to, have recognised the right of owners of property to be consulted in such matters, there are probably many instances in which the line staff, for their own convenience, have taken French leave. Those who have agreements with the company granting facilities of this kind, as well as property-owners generally, are naturally anxious to know how they will stand with regard to telephone wires and posts with the Post Office. Enquiry has been made by the Birmingham Chamber of Commerce, and a reply has been received to the effect that as regards poles in hedges and banks on the roadside, the Postmaster-General has certain powers under the Telegraphs Act of 1908 which are not enjoyed by the Telephone Company, and his position with reference to the use of roads and the flying of wires over property differs from that of the company. This reply appearing to the Committee of the Chamber somewhat vague, further investigation of the legal position has been made, and it is found that the Postmaster-General has certain powers in regard to the flying of wires over land and buildings, but it is considered that this does not give him the right to attach wires to private property or to obstruct by such wires the erection of private property. It is understood that a further report with regard to this side of the question will be made to the Chamber.

Municipal versus Government Control.

The question of municipal telephone systems has also occupied the attention of the Chamber, which does not seem inclined to endorse the conclusion of the Telephone Committee of the Association of Chambers of Commerce that the only satisfactory solution of the telephone question would be for the Postmaster-General to empower the municipalities to work the telephone system in their respective areas. The Birmingham Committee believe that it is in the interests of the public that the telephone system of the country should be under the control of either the National Telephone Company or the Postmaster-General, and that it would be detrimental to the public interest that the telephone should be municipalised.

Measured Telephone Rates.

It has been decided by the Chamber to make strong representations to the Postmaster-General against the present excessive measured rates. Under the existing flat

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rate, a subscriber in the provinces making, say, 10,000 outward calls per annum, pays from £7 10s. to £10, whilst a subscriber who has been put on the measured rate approved by the Postmaster-General has to pay a sum of £35 16s. Notice has accordingly been given for a resolution to be moved on behalf of the Birmingham Chamber at the coming annual meeting of the Association of Chambers of Commerce in London, expressing the opinion that the measured rates now in force are excessive, and should be considerably reduced on the transfer of the company's undertaking to the Government at the end of next year.

Birmingham's Oldest Electric Tramway.

The municipalization of the Birmingham tramways, which dates from January 1, 1907, is in two directions still incomplete. The City of Birmingham Tramways Company still holds the lease of the Bristol-road line, while the Handsworth cable tramway, as far as the city boundary at Hockley, though like the Bristol-road line owned by the Corporation, is subject to an unexpired lease to the Birmingham and Midland Tramways Company. Both of these lines, however, will come into the hands of the Corporation on June 30 next year, when the leases expire. The Bristol-road line will be remembered by those interested in tramway development as the subject of the first local experiment in electrical traction. The late Mr. Pritchard, who was then electrical adviser to the Corporation, devised a system of accumulators on the cars and charged at the station at Bournbrook. For a time the experiment seemed promising, but the construction of cars adapted to electrical propulsion was not then sufficiently understood, and eventually the service degenerated more and more until it became ridiculously inefficient. It was a common thing at last for a car to stop dead in the middle of a journey, and an engine from the despised steam tramway had to be brought to the rescue.

Aesthetics and Public Convenience.

The overhead system was bitterly opposed by many residents on the route, but the improvement in the service and the care which was taken to minimise any possible unsightliness have long ago reconciled all concerned to the change. It is rather curious that when the first suggestion of an overhead traction line was made for a district of the city, which one would think it almost impossible to disfigure it, was scornfully rejected on aesthetic grounds, and yet the system so condemned found its first application in the city on the Bristol-road which, with its long avenue of well grown lime trees and superior suburban residences, is regarded as the finest the city possesses. This tramway is in immediate want of relaying, and an arrangement has been come to by which the lines to the city boundary shall be relaid by the Corporation at once, the company paying interest on the outlay at the rate of 10% per annum until June 30, 1911. The contract has been let to Messrs. Griffiths & Company, and the work has been commenced from the outward end. The Hockley cable tramway will be converted into an overhead electric line, and the rest of the cable route which will fall into the hands of the Handsworth District Council—should such a body be then in existence—at the same date will be similarly dealt with. With the extensions which the Handsworth Council already have in hand, this will give Birmingham direct communication with a number of overhead routes in the Black Country, and it is anticipated that should the Greater Birmingham Scheme include Handsworth, as has already been decided by the House of Commons Committee, extensive arrangements with regard to through running in a large district, of which Birmingham is the centre, will result.

SCOTLAND.

("Electrical Engineer" Correspondent.)

GLASGOW.

The central station engineer no longer knows the old-time period of break-neck rush followed by a time of comparative ease; nowadays it is rush all the year round. Now that we are into the heart of the winter the central station engineer finds himself living a day at a time, in the knowledge that any big breakdown at this season would be calamitous indeed. Every precaution has been taken both in the works and on the mains, but unforeseen contingencies will arise in spite of all that the most painstaking and far-sighted of engineers can do. Nevertheless, during these weeks of mental tension, there is little time to spare for mere watchfulness; next winter's load must be anticipated, and preparations must be entered upon and schemes and estimates prepared at once to get the necessary powers to proceed, so that whatever new plant is required will be delivered in time.

Extensions at Edinburgh.

The Edinburgh Corporation Electricity Department are to apply to the Secretary for Scotland for leave to borrow an additional £75,000 in connection with the capital expenditure of their undertaking. In the meantime they are getting in estimates for the external parts of the proposed two cooling towers. One is glad to have the assurance that these towers will not interfere with the architectural amenities of the Scottish capital.

Greenock Electricity Department.

The electrical undertaking of the Greenock Corporation continues its course of rapid development. The proposed supply to Port Glasgow is maturing and the question now under consideration seems to be whether the power users in the extended area will be asked to give a combined guarantee or individual guarantees. In the meantime the engineer, Mr. J. F. Robertson, is to ascertain the extent to which the power users are prepared to give individual guarantees. In any case the considerable applications from Scott's Shipbuilding Company and the Torpedo Factory of the Admiralty for lighting and power supplies spell an expenditure of some £22,000 on extensions of buildings, plant and mains at Dellingburn Works and elsewhere. It is estimated that these extensions will meet the ordinary requirements for the next three or four years.

Scottish Exhibition of 1911.

The building which is to house the electrical plant at the above exhibition is now well in hand and the order for the plant is to go to the British Westinghouse Company. There will be three 500 kw. rotary converters and one rotary converter of 250 kw., all four machines to transform from 6,500 volts to 500 volts. There is also the necessary high and low tension switch gear. The Westinghouse Company have offered this whole plant at £4,805 and it will be taken over by the Corporation Electricity Department at that figure after the close of the exhibition, as and when they may require it.

Slaughter House Lighting.

The Glasgow Corporation Markets Department are asking for tenders for the wiring of their new slaughter houses. It says much for the moderation and balance of the Town Council that they persist in leaving such work to the private contractor instead of handling it over to a wiring staff of their own to carry out. The installation in this case will run to some 700 lamps including 20 8-ampere flame arcs.

Ayr Tramway Extension.

The Ayr Town Council have under consideration the extension of their tramway system to Hawkhill in accordance with Parliamentary powers already obtained. The cost of the extension has been variously estimated at from £13,000 to £18,000.

New Tramway Route to Rouken Glen.

The tramway line from Barrhead to Rouken Glen, inspected the other day by Colonel Yorke, is now open. The power for the new route is to be obtained from the new sub-station at Barrhead which in its turn draws its energy from the Clyde Valley Company's power house. The new route completes a circuit which includes Barrhead, Paisley, Renfrew, across the ferry, and thence to Glasgow via Partick. Reference to Barrhead brings to mind the fact that the Clyde Valley Electric Power Company have just extended their mains a quarter of a mile along the main street of Barrhead and are now giving power and lighting supplies there. Two lamps have been erected in Main Street by the Company as a test of street lighting.

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UNITED STATES.

("Electrical Engineer" Correspondent.)

NEW YORK.

The new phase of the electric subway situation brought about by the proposals of Mr. Frank J. Sprague, is the most interesting development of the week in this especial branch of electrical development. Mr. Sprague suggests two methods of dealing with a complicated and difficult problem—one, a compromise in the matter of extensions on the basis of civic participation in profits after certain charges have been met; and, two, an alternative plan for independent lines on which he is prepared to guarantee an arrangement for operation, the city sharing both in profits and in management. He points out that on the one hand there is a great municipality with constructive rights of franchise over every unoccupied street within its limits, the power to grant valuable elevated privileges and extensions, absolute title to a property costing nearly $63,000,000 and operative possession after a period of years, an administrative power to determine the character and frequency of service on existing roads, and a present basic available capital of $60,000,000, with regular annual increase obtainable on interest terms denied to any private corporation; and on the other, a private operative company with two profitable leases: one, of an old-established elevated system built with private capital, and with practically unlimited franchise, and the other a limited but profitable contract with a city owned system, and with $31,000,000 invested in an operative equipment, practically useless at the end of its lease unless taken over by the city, which the city at that time has the right to take over on reasonable terms. The compromise scheme should, he suggests, be based on an agreement to abandon the projects for competitive subways and the progressive expansion of the present system under the guidance of an engineering board composed of representatives of the city itself, of the Public Service Commission, and of the Inter-borough Rapid Transit interests. Extensions would be made with city funds, but operative equipment would be provided from private sources, the profits to be shared on a basis of gradually increasing participation by the city, while sinking funds would be established to provide for all interests. This plan, Mr. Sprague urges, could well be accepted by the Public Service Commission, since it would ensure the establishment of the projects for which the Commission was created, which the Inter-borough Company could equally well acquiesce because of the removal of the threat of competition and of the necessity of raising funds for private construction, the elimination of the constant friction between itself and the Commission, the assurance of maintenance of earnings and a probable increase in the stability and value of its securities. But if the Inter-borough Company will not join in this proposal, Mr. Sprague urges the Public Service Commission to do what any competent private corporation would do—instead of attempting construction of a partly competing route on extravagant plans, made still more so to the extent of nearly $30,000,000 in the hope of getting a foreign railroad corporation to assume the burden not alone of the system but the added increase of cost—seize upon every strategic route sought by the Inter-borough interests which can be moulded into a coherent workable system, construct it on sane lines at the minimum cost, so that it will attract and would maintain profitable independent operation, and when such is established compel joint operation, a reasonable voice in management and a fair division of profits.

Electrically Operated Tannery.

The Allen tannery, of Kenosha, Wisconsin, one of the largest institutions of its kind in the United States, has recently adopted electric drive in its 20 extensive buildings with complete and unqualified success. The system adopted, owing to the large area covered by the works, is partly that of individual and partly that of group drive, and two power plants have been established, one equipped with a 2,405 ampere, 240-volt, 60-cycle, three-phase alternator, belt-driven by a 24 by 48 wheellock twin engine, and the other with a 1,445 ampere, 240-volt, 60-cycle, three-phase alternator driven by an Allis-Chalmers Corliss engine. Water supply is drawn from the adjacent river by means of two centrifugal pumps operated by two motors, one of 50 h.p. and one of 60 h.p. The mills for preparing bark for the tannery process are operated by a 125 h.p. motor, and motors of 15 h.p. and 10 h.p. operate the conveyors carrying the spent tan to an elevator and thence to the boiler house. There is also a motor driven air-compressor to supply the air for handling the tan liquor. The machinery for removing hair from the lime-soaked hides and for washing and reeling them is driven by one 10 h.p. and two 15 h.p. motors, while the drying is accomplished by means of a ventilating fan driven by a 5 h.p. motor. After rewashing, the hides are trimmed and scoured by means of machines each operated by 20 h.p. motors, and other motors running up to 50 h.p. operate the finishing machinery. The installation has proved both more economical and more efficient than the steam drive previously in use, and the Allen Sons Company are warm in its praises. An illustrated description of the institution appears in this week's number of the Chicago "Electrical Review."

The Surging of Synchronous Machines.

Taking as the basis of his analysis the case of a synchronous motor operating from a large system, Professor Ernest Berg of Illinois University, presented at a joint meeting at Chicago of the A.I.E.E. and the Electrical Section of the Western Society of Engineers, a paper on the Surging of Synchronous machines which contains many valuable conclusions. Professor Berg traces surging to insufficient damping of the magnetic circuit, or alternatively to too much damping. The flux produced by the field excitation, he pointed out, is constant so long as the exciting current is constant, but with sudden change in excitation, it changes slower than the change in excitation on account of the eddy currents which oppose the change. The time required to build up the magnetism in the field may vary, according to the field construction, from a fragment of a second in laminated structures to 10 seconds or more in solid steel structures, or those of laminated steel with imbedded squirrel-cage windings; and it very seldom happens that the structure is such that no eddies occur. Two machines may thus have the same electrical constants, the same armature resistance and reactance, the same excitation at full load and no load, and the same armature reaction, and yet their characteristics at the instant of change of load may be very different. In the calculations of generator characteristics the term "synchronous reactance" is really, in Professor Berg's view, only justified in an ideal generator having uniform magnetic reluctance in all positions of the armature, and having a magnetic structure which permits the flux to change at once with the change of magnetomotive force. In a machine with squirrel-cage winding in the poles this condition is not fulfilled. The result of this is that if, for instance, full load is suddenly thrown on the machines of the two types, in the first type the machine will take its load when the speed has dropped so that the angle between induced electromotive force and terminal electromotive force is, say 15°, whereas in the latter type it may be only 1°, though after a short time the two machines will have the same phase displacement between the induced and terminal electromotive force. The same applies to the synchronous motor, but in this case the different characteristics play an important part in the stability of operation. While a motor with excessively damped field-circuit can be loaded up to the same output as the ideal type, if the load increases slowly so that the armature reaction has time to exert its influence, it will break down immediately if suddenly more than about 20% of full load is thrown on it. If a motor of the laminated-field type, is operated over a line of 10% resistance and 20% reactance the total reactance would then be 87%. Such a motor is not able to carry full load and it is extremely sensitive from half load up. Thus, too much reactance is as detrimental as too low reactance. A motor of this latter type would undoubtedly benefit by a squirrel-cage winding on the field, since such a winding reduces the armature self-induction to some extent. Such a motor would run much more stably if by some arrangement of the supply circuit its reactance could be decreased. Every synchronous machine has a natural period, that is, a period at which it will oscillate when adjusting itself from

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one load to another, and this period is practically proportional to the square root of the field-excitation and inversely proportional to the square root of the moment of inertia. This period is usually between one-ninetieth and one-sixtieth of a second. While such oscillations always take place with changes of load, they are usually of little importance since they cover a small phase-angle only. If, however, says Dr. Berg, the synchronous motor is supplied power from an alternator whose speed for some reason or other pulsates at the same rate as the natural period of the motor, then a condition of resonance takes place and the machines cannot overate satisfactorily in parallel.

Some Suggested Remedies.

The remedy, of course, is to change the natural period either by increasing or decreasing the moment of inertia or by changing the air gap, and, therefore, the excitation. Finally, Dr. Berg urges that in general it can be concluded, as far as the electrical side of the surging problem is concerned, that it can be solved by one or more of the following alternatives: (1) reduce the ohmic resistance between the machines: (2) exclude all external reactances and put field-damping devices on machines of laminated fields and quick magnetic circuit, especially if the synchronous impedance is great; that is, if they, as generators, have poor regulation; (3) add extra reactance in high-speed machines having good mutual induction between field and armature and sluggish magnetic circuit; (4) change the natural period by change of air-gap or addition of flywheel, etc. But Dr. Berg while thus disposing of the electrical side of the problem, is convinced that 95 cases of surging out of every 100 can be traced back to some mechanical defect of the prime mover. Usually the governor is too sensitive, or there is some play in the various links connecting the governor proper with the steam-admitting valves. Sometimes, by the very nature of the drive, difficulties can be anticipated; for instance, when several generators or motors are belted to the same countershafting, when it is always possible that the pulleys might be of slightly different diameters or the belts of greatly different quality. In the case of hunting between direct-connected engine-driven units, it is easily ascertained if the governing mechanism is at fault by disconnecting it and operating by throttling. Should hunting still persist, it would seem necessary to resort to some of the three electrical remedies suggested, and if these are impractical, to add some flywheel capacity. It is believed that any surging difficulty can be solved by the remedies suggested; indeed, with practical experience of a large number of cases, Dr. Berg, has never, he declares, met a case which could not be disposed of by them.

Voltage Wave Distortion.

The conclusions arrived at by Professor Kinsloe as a result of his life-test experiments with incandescent lamps, a synopsis of which was transmitted the week before last, are warmly disputed by Mr. Clayton Sharp of this City, in a communication to the "Electrical World." Mr. Sharp complains that the conditions under which the tests were made are not sufficiently explained, that it is not stated how the lamps were burned, or whether the "smashing point" was an actual or an arbitrary point, nor whether the watts were measured on the d.c. or a.c., or if the latter, with what kind of instrument. Mr. Sharp says that it is certain that lamps can be burned at the same watts per candle on peaked wave that they can on sine wave, as that is only a question of the voltage, and just as certainly lamps can be made to give as much candle-power on peaked wave as on sine wave, as that is also a matter of the voltage. If two lamps which are supposed to be exactly alike, are operated one from the sine wave and the other from peaked wave, and are found at the same voltage to give different candle-power and different watts per candle, the natural inference, says Mr. Sharp, is either that the measurements are in some particular incorrect or that the lamps are not alike. He goes on to point out that tests to determine the relative life of carbon lamps on direct current and on 25-cycle and 60-cycle sinusoidal current were which were made at the Electrical Testing Laboratories, and in which 150 lamps were divided into three groups of 50 lamps each, the results were as follows: Taking the average effective life of the 60-cycle lamps as 100%, the life of the lamps on 25 cycles was 104% and that on the direct current was 94%. These results were at that time (1905), and are still, considered as inconclusive as far as pointing out differences in the life of carbon lamps on direct-current and alternating-current circuits is concerned, the observed differences being attributed to the differences in individual lamps and to the necessarily different regulation of the different generators. But, what difference between direct-current and alternating-current tests is shown is directly contrary to what would be expected from Prof. Kinsloe's results. In another experiment made by the Electrical Testing Laboratories, the arrangements were changed from a 133-cycle peaked-wave generator to a 60-cycle sine-wave generator. An attempt was made at that time to establish any systematic differences in the life of the lamps produced by this cause. The wave form of the peaked-wave generator showed a third harmonic 20% of the fundamental, whereas the sine-wave generator showed a third harmonic 4·7% of the fundamental. The peak of the one machine was 18% higher than that of the other for the same mean effective value: so that unless it can be urged that the higher frequency of the peaked-wave machine masked the effect of the peaked-wave form, this test would also, says Mr. Sharp, seem to furnish negative evidence with regard to Prof. Kinsloe's results. Finally, Mr. Sharp observes that "tests made on the earlier makes of tungsten lamps on direct current and on alternating current indicated quite positively that no difference in their life was to be expected. These indications were so clear that, in the absence of anything to arouse suspicion to the contrary, the Electrical Testing Laboratories has not made similar tests on modern tungsten lamps. The ordinary squirted tungsten filaments which have been burned for 1,000 hours on alternating current do not show under the microscope any obvious cause for failure such as the faulting which is so characteristic a feature of tantalum filaments which have been burned on alternating current. This piece of negative evidence indicates that if the life of the tungsten lamp is really shorter on alternating current than on direct current the shortening is for some other reason than that which affects the tantalum filament."

Efficiency and Temperature.

At the recent meeting of the American Physical Society Mr. W. E. Forsythe, of Wisconsin University, presented a paper on the luminous efficiency of incandescent lamp filaments, setting forth the results of an important series of experiments. In these tests, which were undertaken to show the variation of the efficiency of the different filaments as a function of the true temperature, and efficiency was defined as the ratio of the energy in the visible part of the spectrum to the total energy. The efficiency in candlepower per watt was measured as a function of the temperature. To measure the energy in the visible spectrum, while it was giving as much light as the total radiation, light was brought out along two paths, from the same source, the one being dispersed and a screen so set as to cut off the infra-red radiation at the A line, and then the remainder recombined and balanced photometrically against the total radiation. To bring this back in line with the total radiation required a bent-arm spectroscope. The temperatures were measured with a Holborn-Kurlbaum optical pyrometer. This gave black-body temperatures which were corrected to true temperatures. The running temperatures of the different lamps were measured by the method due to Waidner and Burgess, which consists in putting the lamp studied in place of the comparison lamp of an optical pyrometer and balancing against a source with known temperature. The energy in the visible and the total spectrum was measured by a Rubens thermopile connected to a Broca galvanometer and so adjusted as to have a sensibility of about 300 candle-meters. To make the deflections of the galvanometer about the same in each case a revolving sectored disc was used in the path of the total radiation. Carbon, tantalum and tungsten filaments were used, and it was found that for the same efficiency the carbon has the higher temperature, while for the same temperature the metal filaments give higher efficiency. When operating under rated conditions the metal filaments are at higher temperatures

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than the carbon filaments, so that the better commercial efficiencies are due in part to selective emission and in part to a higher working temperature. In the curves tantalum shows better characteristics than tungsten, that is, higher efficiency at the same temperature or lower temperature for the same efficiency. This does not agree with the work of Hyde, which showed tungsten more selective than tantalum.

Current Items.

A great campaign for the popularisation of the electric vehicle is to be entered upon in the New Year by the Electric Vehicle Association of America, and $50,000 a year will be spent on publicity in the next three years. The chairman of the Publicity Committee is Mr. N. F. Brady, first vice-president of the New York Edison Company, and the following leaders in the electric lighting industry are members:—Messrs. N. F. Brady, Samuel Insull, J. B. McCall, C. L. Edgar, W. W. Freeman, Charles R. Huntley, Alexander Dow, George H. Harries, Samuel Scovill, F. W. Frueauff, H. M. Byllesby, J. G. White, A. H. Ford, T. N. McCarter, Thomas Dolan, R. F. Pack, Arthur B. Lisle, Marcy L. Sperry, R. M. Searle, John B. Miller, John A. Britton, Alton S. Miller, G. W. Brine.

The Committee on Rivers and Harbours has decided to give a hearing on January 6 on the Bill introduced last session by Representative Alexander increasing the amount of water to be diverted from Niagara Falls for power purposes to 20,000 cubic feet per second, in accordance with the provisions of the treaty negotiated with Canada. At present the diversion is limited to 16,000 cubit feet per second.

The United States Navy Department is to make experiments with electric lifting magnets for recovering torpedoes which are fired in practice and which, through some fault of the controlling mechanism, go to the bottom after their energy is expended. Owing to the buoyancy of the water magnets of relatively small lifting power may be used, but it will be important that these be constructed to withstand the severe conditions of moisture and temperature changes under which they will be operated.

Satisfied as to their marked economy over other forms of lighting, the Chicago Electric Railway Company has installed tantalum lamps in nearly 1,000 large pay-as-you-enter cars. The investigations show an average saving of 5 cents a day per car on the basis of 1,800 hours of illumination per year. This means a present saving of $18,000 a year, and fully $35,000 a year will be saved when the tantalum lamps have been placed in all of the 2,000 cars to be finally operated by the company. The greater cost of the tantalum lamps compared with carbon lamps, including interest, is found to be balanced at the end of the first year by the longer life of the former lamp. Twenty-seven lamps are used in each car, seven of 32 c.p. and 20 of 16 c.p. Twenty-one lamps are used for interior lighting of the car and the remainder for platform lighting, head lighting and illuminating the sign boxes.

NOTE.—In reply to numerous correspondents who have made inquiries with regard to the publication in book form of the 36 lectures on Illuminating Engineering recently delivered at the Johns Hopkins University, we are only able to say at present that it is not expected that the first set of two volumes (of about 700 pages each) will be available until the middle of January next. The actual price has not yet been fixed, but it will probably be about 22s. per set, including postage to this country. Subscriptions should be sent to the Johns Hopkins University, Baltimore, Maryland.

ARC LAMP BENEFIT SOCIETY.

The annual meeting of the Arc Works Voluntary Sick Benefit Society was held in the Recreation Room at the Arc Works on Saturday, December 10, 1910, Mr. Claud Crompton in the chair.

The balance sheet was read by the Secretary, Mr. W. G. Bickmore, and was unanimously adopted.

The Chairman then read the report for the year, which showed that the contributions to the general fund amounted to £263 10s. 4d.; the donations from Messrs. Crompton & Company, Ltd., for additional sick pay were £67 14s. 10d., making with 5s. 9d., the balance of dividend brought forward from the previous year, total receipts to the general fund of £331 10s. 11d.

The expenditure had been by sick pay £266 8s. 8d., management expenses, including printing, stationery, postage, cheque book and officers' salaries £20 2s. 4d., leaving a balance in hand for distribution of £44 19s. 11d.

The society had lost through death four members and three members wives, and the total amount paid for funeral claims was £113 6s. 6d. The reserve fund showed a balance at the bank of £102 4s. 8d.

No claim for compensation for loss of work owing to contagious disease prevailing at the home or lodgings of a member had been made during the year.

The retiring members of the committee, Messrs. Everard, Horsnell, James, Swash, Walls, Jackson, Oliver and Suckling, were re-elected, and Mr. G. Clements was elected in place of Mr. Ody, who had left the service of the company.

Mr. W. G. Bickmore was re-elected secretary, and Mr. P. G. Cheverton and Mr. W. Everard were re-elected auditors.

At the conclusion of the business of the Sick Benefit Society, the annual meeting of the subscribers of the Arc Works Voluntary Infirmary and Dispensary Fund was held, Mr. C. Crompton again presiding.

The hon. secretary, Mr. W. G. Bickmore, read the balance sheet, which was unanimously adopted.

The Chairman then read the annual report, which showed that the fund started the year with a balance in hand of sevenpence. The subscriptions of a penny per month amounted to £23 17s. 4d. The expenditure was by donations to the Chelmsford and Essex Hospital £10 10s., and to the Chelmsford Dispensary £13 2s. 6d., leaving a balance in hand of 4s. 10d.

There had been distributed during the year 10 hospital letters and 75 dispensary letters. The larger number of these letters had been issued for the wives and families of the subscribers; six of the hospital letters had been issued to children, principally for operations which had been ordered by the medical officer inspecting the schools for the district.

The report was adopted as read.

The hon. secretary was re-elected.

The Chairman then read the report for the year of the Arc Works Benevolent Fund, which is supported entirely by the directors of Messrs. Crompton & Company, Ltd. Several deserving cases had been brought to the notice of the committee, who had recommended that grants be made, and in all the cases the directors had confirmed their recommendations. The total amount granted during the year was £11 8s., which was paid in sums varying from 5s. to 7s. per week.

Mr. Everard moved, and Mr. James seconded, and it was carried unanimously, that the best thanks of this meeting be accorded to the directors of Messrs. Crompton & Company, Ltd., for their generous support and the kindly interest they take in all the institutions of the Arc Works which conduce to the welfare, pleasure and comfort of their employees and also their employee's wives and children.

A hearty vote of thanks was unanimously accorded to the Chairman for presiding, who, in reply, said he was always pleased to do all in his power to help forward the work of the Arc Works societies.

NEW YEAR GIFTS.

The Hart Accumulator Company, Ltd.: Convenient desk blotting pad.

Messrs. Alfred Graham & Company: Desk blotting pad with diary attached.

Messrs. Haslam & Schonteil, Ltd.: "Squared" tear-off sketch or scribbling block.

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PAISLEY DISTRICT TRAMWAYS ARBITRATION.

We give below the award recently made by Mr. Robert Hammond in the Paisley District Tramways case :—

1. That the rates to be paid by the Paisley District Tramways Company to the Paisley Corporation for the supply of electrical energy for the Tramways for a period of seven years from the Sixteenth day of August, One thousand Nine hundred and ten, shall be as follows, *videlicet* :—

   For each year of the period a fixed sum of

   £4 15 0 (Four pounds fifteen shillings) per Kilowatt of the maximum power delivered to the Tramway Feeders during the year and determined as hereinafter mentioned, and in addition, subject as hereinafter mentioned, a sum of

   ·475d. (Four hundred and seventy-five thousandths of one penny) per unit for all units delivered to the Tramway Feeders and metered at the Generating Works.

2. The maximum power delivered to the Tramway Feeders during any year shall be taken to be the average power delivered to the Tramway Feeders during that period of thirty consecutive minutes in which the electrical energy supplied to the Company is a maximum for the year. And, Whereas, in fixing the above prices the Arbiter has *inter alia* been guided by the cost of coal and other fuel for the year ended May Fifteenth, One thousand Nine hundred and ten. And Whereas, during such year, as shewn by the Corporation's Published Accounts, the cost of coal " and other fuel " was £3,294 15s. 3d., and the number of units generated was 3,035,698, and the quantity used on works 408,936 units, and, therefore, the quantity delivered to the Feeders 2,626,762 units, and the resultant cost per unit delivered to the Feeders was ·301d., he further awards and directs that the aforesaid ·475d. per unit payable by the Tramway Company shall in each year be increased or decreased as the case may be by an amount equal to the difference between the actual cost per unit delivered to the Feeders of " Coal and other Fuel " to the Corporation in that year and ·301d. per unit.

The Arbiter also directs that, pending the determination of the amount of the maximum power and of the coal cost each year, monthly payments on account shall be made by the Company to the Corporation as follows :—

£275 0 0 (Two hundred and seventy-five pounds) in respect of the Kilowatt Charge.

·475d. (Four hundred and seventy-five thousandths of one penny) per unit for all units supplied, and the necessary adjustments of the account shall be made at the end of each complete year.

For the determination of the average power referred to above, the Arbiter has assumed that an integrating wattmeter will be employed, so arranged with auxiliary mechanism, that it will automatically record the maximum consumption of electrical energy during periods of thirty consecutive minutes, the number of kilowatts of average power being twice the number of units so recorded.

MINING INSTITUTE OF SCOTLAND.

A general meeting of the Mining Institute of Scotland was held in the hall of the Institution of Engineers and Shipbuilders, Glasgow, Mr. Robert M'Laren, H.M. Inspector of Mines, presiding. The Secretary (Mr. James Barrowman) read a memoir which had been prepared of the late Mr. James M'Creath, Bothwell, an ex-president of the Institute, and stated that an expression of sympathy as to Mr. M'Creath's death had been sent to his relations. The Secretary reported that the council recommended that the headquarters of the Institute be removed from Hamilton to Glasgow as being a more convenient centre. It was not proposed to have all the general meetings in Glasgow, but to have meetings in other centres, as at present. The Institution of Engineers and Shipbuilders had offered them such terms for the use of part of their premises as would eventually effect a considerable saving to the Institute. The council's recommendation was unanimously adopted. A discussion took place on a paper by Messrs. Robert Crawford and Harold Moores on " Power Production at Collieries, with Special Reference to Gas Power and Electrical Centralisation," and Mr. George Stevenson read a paper on " Recent Progress in Mining Switchgear."

INSTITUTION OF ELECTRICAL ENGINEERS (YORKSHIRE LOCAL SECTION).

A reception was held by the Chairman of the Yorkshire Local Section, Mr. T. Harding Churton, followed by a smoking concert, at the Hotel Metropole, on December 13. There was a good attendance of members and their friends, and an excellent programme of vocal and instrumental music was greatly enjoyed. Mr. Kitchen's orchestra played the march " Pomp and Circumstance " and the morceau " Salut d'Amour " (Elgar), the graceful dance " Henry VIII. " (Sullivan), selection from " Merrie England " (Ed. German); violin solos by Tenaglia, Beethoven, Gossec-Moffatt, Saint-Saens, Porpora, and Paganini were contributed in masterly style by Mr. Montagu-Nathan; while Messrs. R. Wilson, S. H. Smith and W. E. Lang sang a number of songs, which completed a most enjoyable entertainment. At the conclusion of the concert, a hearty vote of thanks to the Chairman, proposed by Mr. Wilson Hartnell, and seconded by Mr. W. M. Rogerson, was carried with acclamation.

DIARY.

SATURDAY, DECEMBER 31.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (South Wales Branch).—At the Hotel Metropole, Swansea, 3.30 p.m., discussion to be resumed on " The Inspection and Repair of Electrical Plant Underground," by Mr. R. R. Smith.

SATURDAY, JANUARY 7.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Bride-lane, E.C., at 7.30 p.m., Social Evening and Dance.

MONDAY, JANUARY 9.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Association).—At the Institution, Storey's-gate, Westminster, 8 p.m., Mr. G. L. Copping on " Air Movers."

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Students' Section).—School of Technology, at 7.30 p.m., G. D. L. Horsburgh on " Large Gas Engines."

WEDNESDAY, JANUARY 11.

INSTITUTION OF ELECTRICAL ENGINEERS (Yorkshire Local Section).—The University, Leeds, at 7 p.m., Dr. Henry Strond on " Radio-Telegraphy."

MONDAY, JANUARY 16.

LEEDS UNIVERSITY ENGINEERING SOCIETY.—Professor S. A. Bone on " Development of Power from Blast Furnace Gas."

TUESDAY, JANUARY 17.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS.—In the Rooms of the Junior Institution of Engineers, Victoria-street, Westminster, at 8 p.m., discussion on Mr. E. Kilburn Scott's paper on " Electricity in New South Wales Collieries."

INSTITUTION OF ELECTRICAL ENGINEERS (Manchester Local Branch).—Mr. Harold Gray on " Electric Heating as Applied to Cooking Apparatus."

THURSDAY, JANUARY 19.

RUGBY ENGINEERING SOCIETY.—Benn Buildings, Rugby, at 8 p.m., Mr. J. Miller on " Electric Power in Collieries."

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Business Notes and News.

LIGHTING AND GENERAL.

HOME.

BELFAST.—The electrical engineer reported, and a sub-committee was appointed as a consultative committee to advise him, as occasions may require, on matters connected with coal supplies. He stated that considerable progress had been made in connection with the proposed electrical exhibition, which is to be held in the Ulster Hall for the two weeks commencing January 9, and that it promises to be a great success.

BURY PORT.—The District Council have decided to abandon the idea of applying for a Provisional Order for electric lighting.

BUCKHAVEN.—At a special meeting of the Town Council a deputation was appointed to meet the Fife Electric Power Company and confer as to the extent of the powers sought by the company in the burgh with a view to taking steps to conserve the rights of the community.

EAST HAM.—At a Local Government Board inquiry into an application to borrow £17,430 for purposes of the electrical undertaking, the Inspector said that in view of the indebtedness of the borough and the high rates, capital charges should be kept down and "unremunerative" work be paid out of revenue.

GREENOCK.—In order to carry out the electricity works extension scheme, it has been decided to apply for the sanction of the Secretary for Scotland to an increase of £22,000 in the borrowing powers of the Corporation. The proposed scheme includes the extension of the present buildings and the installation of two large boilers and a steam turbo-generator.

HULL.—The Electric Lighting Committee are recommending the Council to proceed with extensions and the installation of modern machinery at an estimated cost of £90,000 or £100,000. The proposal is to build a new power house on land adjoining the present power house at Sculcoates-lane. The building would eventually "house" machinery of a total capacity of 16,000 kw. The system to be adopted is more modern than the existing one, and it will be possible to produce electricity at the very lowest cost.

LEICESTER.—Mr. James Swinburne has given in his report on the question of amalgamating the electric light generating station at Aylestone and the tramways power station at Lero. He recommends that the two should be linked up, so as to secure greater safety, efficiency and economy. It is estimated that when the work is completed a saving of about £2,000 a year will be realised. The recommendation is to be adopted, and the two undertakings placed under the control of the Tramways Committee.

MAIDSTONE.—A Local Government Board inquiry has been held into an application for powers to borrow £4,000 for the electricity undertaking. Opposition was offered by the local gasworks and half-a-dozen ratepayers. The Town Clerk pointed out that its electricity had enabled them to save £300 a year on public lighting.

NEWARK.—The Board of Trade propose to revoke the Provisional Orders granted to the town under the Electric Lighting Acts unless sufficient reason is shown for the delay.

PLYMOUTH.—With reference to the question of electric lighting, the Lighting Committee reported that the draft of the agreement with the New Development Company, Ltd., was submitted, and it was decided to recommend the Council to give the consent asked for, but to be advised by an expert as to the form of agreement. The minute was confirmed by the Council, it being pointed out that the acceptance of the agreement did not commit the Council to anything.

ROSSLARE.—The wireless station is now put in communication with the whole telegraphic system of the United Kingdom.

SOUTHEND-ON-SEA.—Subject to the Local Government Board sanctioning the borrowing powers asked for, the Council have decided to accept the following tenders for plant required at the new Chalkwell Park battery storage room:—Lancashire Dynamo Company, of Old Trafford, Manchester, booster plant, £1,696 5s.; Ledward & Beckett, of 11, Tothill-street, S.W., distilling plant, £136; Crompton & Company, of Chelmsford, balancer, £254; the Cloride Electrical Storage Company, Ltd., of Westminster, S.W., traction booster, £528 10s.; and Morris & Bastert, of Loughborough, overhead crane and blocks, £46 16s.

OVERSEAS.

BUENOS AIRES.—The text of a Bill has been issued granting, in favour of the Department of the Interior, a supplementary credit of 1,395,000 pesos (about £122,000) for the following purposes:—The construction of telegraph lines between Gualeguay and Rosario de Tala; Villaguay and Concordia; Federal, Feliciano and La Paz; Posadas and Ituzaingo; Rosario and Cordoba; Buenos Aires and Zarate; Zarate, Baradero and Gualeguay; Santa Fé and Parana; Santa Fé and Galvez; £26,000 will be devoted to the building of Post Office stables and workshops, and £9,000 will be utilised for repairs to, and the construction of, new telegraph lines and cables running to the Chilean frontier.

DURBAN.—The borough electrical engineer, in his report for the year ending July 1, states that the Council have sanctioned the expenditure of nearly £20,000 for the extension of the electric power station plant. Two turbines of 3,000 h.p., suitable for generating high tension electricity, giving three-phase current at 6,600 volts, are to be purchased immediately. The report also states that the metallic filament is now established in public favour in Durban. The sale of small electric kitchen utensils, such as irons and kettles, has considerably increased. The electrical engineer recommends that further encouragement should be given to the use of the larger electric domestic apparatus.

MELBOURNE.—The City Council have decided to extend the electrical plant by the erection of an accumulator battery. It was estimated that the total cost of the extension would be £29,540, including £21,000 for a 1-4,000 ampere-hour accumulator battery, with switches, connections, booster, etc., and £540 for pilot cables, etc.

SAN THOMÉ.—The municipality propose establishing an electric light and power supply (see Contracts Open).

SAO PAULO, BRAZIL.—A concession has been granted to Gabriel da Silveira Basconcellos (address not stated) for the establishment and working of a telephone line designed to connect the town of Campinas with the municipal districts of Limeira, Araras, Pirassununga, Belem do Descalvado, Santa Cruz das Palmeiras, Casa Branca, Senta Pita do Passa Quatro, Sao Simao, Cravinhos and Ribeirao. A period of six months from October 16 last is allowed for the commencement of work.

TRACTION.

HOME.

RICHMOND.—The Council have decided not to oppose the Bill to be promoted by the London United Tramway Company seeking power to extend the period by which the Kew-road tramway should be electrified until August, 1912.

SOUTHEND-ON-SEA.—Application is being made to the Board of Trade for permission to double considerable sections of the light railway track.

OVERSEAS.

BARCELONA.—The Direccion General de Obras Publicas, has had an application lodged by the Sociedad Anonima El Tibidabo for the construction and working in Barcelona of an electric tramway, to run in two sections from the Apeadero del Observatorio, viz.: (1) to the Cuspide del Tibidabo and (2) to the Collado de Vista Rica.

PALMA.—The Ministerio de Fomento, Madrid, announces that a concession has been granted to Don Mariano Gual, Conde Ayamanes, and Don Alfonso Chopitea, for the construction and working of an electric tramway from Cas Catala to the station at Palma (Majorca).

COMPANIES REGISTERED.

SCIENTIFIC ILLUMINATION.—Capital, £5,000 (£1). Electricians, mechanical engineers, suppliers of electricity, &c. Agreement between G. St. J. Wood, J. L. Hall, and P. Smith. Private.

PERSONAL.

A meeting of the Metropolitan Association of Electric Tramways Managers has been held, at which Mr. A. H. Stanley, managing director, London United Tramways and London Electric Railways, was elected chairman, and Mr. H. E. Blain, tramways manager, West Ham Corporation Tramways, vice-chairman, Mr. T. B. Goodyer, tramways manager, Croydon Corporation Tramways, was re-elected hon. secretary.

FINANCIAL NOTES.

MELBOURNE TRAMWAY AND OMNIBUS.—Cable advice has been received of the declaration of a dividend of 1½d. per share for the current quarter ending 31st inst. = 15% per annum, payable on January 4 next.

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Electrical Contractors' Section.

A Survey of New Things and Business Prospects.

NOTICE.

Contract and Miscellaneous Advertisements should reach this Office by Mid-day on Wednesday. For rates apply to the Manager, 168, Fleet Street, London, E.C.

CONTRACTS.

HASLINGDEN UNION,

ELECTRIC LIGHTING OF WORKHOUSE AND NEW INFIRMARY.

The Guardians of the Poor of the Haslingden Union invite Tenders for the installation of the necessary equipment for the ELECTRIC LIGHTING OF THEIR WORKHOUSE AND NEW INFIRMARY at Higher Pike Law, Rawtenstall.

The Specification, Form of Tender, and permission to inspect the Plans and Drawings may be obtained on application to the undersigned; a deposit of two guineas (to be returned on receipt of a *bona fide* Tender) must accompany such application.

The Plans, etc., may be subsequently inspected at the Office of the Consulting Engineer, Mr. C. D. Copland, M.I.E.E., 16, John Dalton-street, Manchester.

The Guardians do not bind themselves to accept the lowest or any Tender; moreover, the Tender will be accepted provisionally in the first place, subject to the subsequent confirmation (if necessary) of the Local Government Board and to the entering into a Contract Agreement under Seal.

Sealed Tenders, endorsed "Electric Installation," must reach me on or before Tuesday, January 10, 1911.

By Order,
J. H. SINKINSON,
Clerk to the Guardians.

Union Offices, Rawtenstall,
December 22, 1910.

CONTRACTS OPEN.

HOME.

BURY.—Borough Council. Section A, steel steam pipes, valves, and accessories; section B, cast-iron pipes, valves, and accessories. Specifications, £1 1s. Particulars, see Engines. January 4.

HASLINGDEN.—The Guardians invite tenders for the complete installation of electric lighting at the Workhouse and new infirmary, Higher Pike Law, Rawtenstall. Particulars and specifications (42s.) from the Clerk to the Guardians, Union Office, Rawtenstall.

ISLINGTON.—Borough Council invite tenders for the supply and erection of a high tension switchboard at Eden-grove generating station. Specification, etc., from Chief Electrical Engineer, 50, Eden-grove, Holloway. January 12.

LONDON.—Hackney Guardians. Installation of telephones in pavilions "A" and "B" at the Infirmary, High-street, Homerton, and the removal of the existing installation in pavilion "A." Specification, Clerk, Sidney-road, Homerton, N.E. January 4.

LONDON, WANDSWORTH.—The Council invite tenders for the supply and fixing of street lamp columns, lanterns, fittings, etc., from March 31 next. Specifications from the Council House, Wandsworth. January 3.

SALFORD.—Borough Council. Air lift pumping plant. Specification, £2 2s., Borough Electrical Engineer, Electricity Works, Frederick-road, Pendleton. January 16.

OVERSEAS.

ADRIANOPLE.—The Turkish Ministry of Public Works invite tenders for a concession for the construction and working of electric tramways in Adrianople, and for a concession for the provision of electric light in the Sandjak of Adrianople. The concessionaire will have the right to erect hydro-electric works on the banks of the rivers Maritza, Arda and Tundja. Tenders, which will be opened on March 15, should be addressed to "Monsieur le Ministre du Commerce et des Travaux Publics," Constantinople. Local representation is essential in the case of Turkish Government contracts.

CONSTANTINOPLE.—The Ministry of Public Works invite tenders for a concession for the construction and working of electric tramways in Adana, and for a concession for the distribution of electrical energy in the vilayet of Adana. The Concessionaire will have the right to erect hydro-electric works on the banks of the Upper Seïboun Tchaï River. Tenders, which will be opened on March 14, should be addressed to "Monsieur le Ministre du Commerce et des Travaux Publics," Constantinople, from whom the conditions, etc., can be obtained on payment of 9s. Local representation is necessary.

CONSTANTINOPLE.—The Ministry of Agriculture, Mines and Forests, Constantinople, for the supply for the Cozli-Kilimli Railway of:—(1) 8,550 metres of Vignoles rails weighing 20 kilogrammes per metre, with accessories for the same; (2) three locomotives of 125 h.p., with a gauge of 1·065 metre; (3) 98 coal trucks, of which 80 are to be brakeless and the rest provided with brakes. Delivery is to be made at Cozli or Kilimli not later than March 10 next. No date is mentioned to which tenders will be received. For further particulars application should be made to the above-mentioned Ministry. Local representation is necessary.

MELBOURNE.—Tenders will be received by the Postmaster General's Department, 51, Spring-street, Melbourne, up to noon on March 14, for the supply and erection of installations for wireless telegraphy on Thursday Island and on the coast of Papua. A deposit of £100 will be required with each tender. Local representation is necessary. For copies of the specifications and forms of tender in regard to both of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria-street, S.W., where also preliminary deposits may be paid.

MELBOURNE.—Tenders will be received at the office of the Deputy Postmaster-General, as follows:—(1) Up to 3 p.m. on February 7, 1911, for the supply of 250 ironclad indicators (Schedule No. 423); (2) Up to 3 p.m. on March 7, 1911, for the supply of a branching multiple magneto lamp signalling switchboard and accessories (Schedule No. 361). A deposit will be required on each tender. Local representation is required.

PERTH.—Tenders are invited by the Minister of Public Works of Western Australia for the supply, delivery, and erection of electrical pumping machinery (Contract No. 75). Tenders will be received by the Hon. the Minister for Works, Public Works Office, Perth, Western Australia, up to February 28, 1911. Copies of the condition of contract, etc., may be obtained, on payment of £1 1s., from the Contractor's Room, Public Works Office, Perth, Western Australia.

SAN THOMÉ, PORTUGUESE WEST AFRICA.—The Municipality invite tenders for (5) the supply of electric light and power. Deposit 250 milreis (about £56). Town Hall, Jan Thomé. March 25.

SYDNEY.—The Deputy Postmaster General will receive up to 2.30 p.m. on February 1, 1911, for the supply of a testing equipment, consisting of rotary convertor, transformer, switchboard, etc. (Schedule No. 59.) A deposit will be required with each tender. Local representation is necessary. Note.—For copies of the specifications and forms of tender in regard to each of the foregoing contracts, application should be made to the High Commissioner in London for the Commonwealth of Australia, 72, Victoria Street, S.W., where also preliminary deposits may be paid. Copies of the specifications may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

SYDNEY.—Tenders are invited by the Municipal Authorities for the supply of arc lamp carbons. Tenders should be addressed to the Town Clerk, Town Hall, Sydney, New South Wales, by whom they will be received up to 3 p.m. on February 6, 1911. Specifications may be seen at the office of the City Electrical Engineer, Queen Victoria-markets, Sydney. A deposit will be required with each tender. February 6.

TENDERS ACCEPTED.

BOLTON.—Town Council. W. H. Allen & Company, pumps; T. Francis & Sons, fittings.

BRADFORD.—Town Council. British Thomson-Houston Company, Ltd., Rugby, insulating material; General Electric Company, Manchester, Chatterton compound; M. Goggin and G. Hurtersley & Sons, tapes; W. F. Dennis & Company and F. Smith & Company, wires; Pinchin, Johnson & Company, ferric oxide and dry colours.

MANSFIELD.—Town Council. Meggitt, cable, £119 19s. 9d.

SOUTHEND-ON-SEA.—Messrs. Boydell & Company, of Leigh, for the provision of the feeder and net work pillars, at prices

OSRAM·LAMPS

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amounting to £135 9s. Messrs. Callender's Cable and Construction Company, Ltd., for the provision of the disconnecting boxes, at prices amounting to £29 10s. The Reason Manufacturing Company, Brighton, for the supply of 100 lamp brackets for use on the traction poles, at 13s. each.

SUNDERLAND.—Town Council. Ferranti, Ltd., oil break switch.

WALSALL.—Messrs. Babcock & Wilcox, for boiler with 4,500 sq. ft. heating space, £1,189 6s.; and for fixing same, £150. The Underfeed Stoker Company, for underfeed stoker, £267.

WESTMINSTER.—City Council. Drake & Gorham, Ltd., metallic filament lamps for Caxton Hall; Girdlestone & Company, fitting repairs, etc; Monck-street depot, £26 10s.

OPENINGS FOR TRADE.

Plant, Wiring, Fittings, Accessories, etc.

Agreed upon.

TOWN COUNCILS.

Morley: Extensions, tramway.
Taunton: Plant.
Todmorden: Fittings, wiring, etc.
West Bromwich: Extensions—£9,112.

Contemplated.

Erith: Plant, etc.—£10,000.
Grimsby: Extensions.
Harrogate: Extensions—£2,500.
Handsworth: Extensions, tramway.
Maidstone: Extensions—£4,000.
Uttoxeter: Light and power station.

PRIVATE COMPANIES.

Contemplated.

FIFE: Fife Tramway and Electric Power Company, Ltd., lighting extensions.

PREPAYMENT METERS.

By X. Y. Z.

It has long been recognised that one of the best solutions of the difficulties attending the supply of electricity to small consumers is found in the use of prepayment meters. The advantage from the point of view of the supply authority lies in the fact that, by the use of these devices the number of bad debts is greatly diminished, and the current is paid for before being used, while the small consumer escapes the annoyance and inconvenience of being from time to time called upon to pay an account for electricity used. Additional advantage is found in the method of so adjusting the mechanism of the meter as to make an augmented charge to cover the rental of the meter, and in places which have a free wiring scheme in operation, the hire of the fittings. These considerations have received such wide and ample recognition that prepayment meters are now largely used, and the problem of devising workable contrivances of this kind has successively devolved on all meter manufacturers. An examination of the prepayment meters now on the market shows amply that the success attained in this direction has not been so complete as to remove the necessity for further consideration of the matter. In fact, it can almost be said, without fear of contradiction by any but meter manufacturers, that all forms of prepayment meters exhibit defects more or less grave. These defects are of varied character, and some of them are peculiar to certain types of meter, while others are common to several varieties.

The requisites of a good prepayment meter are many and severe. The meter, containing as it sometimes does, a considerable sum of money, offers a temptation to unscrupulous persons. It is important that no failure of the mechanism shall occur, so as to cause the consumer to have to pay a deficit at the time of collection. Furthermore, the current of the majority of installations on which prepayment meters are fixed is small, and such meters require to be able to register accurately at such loads. The meter should also be of such a design as to render it impossible to obtain current by any other method than by the insertion of a coin, nor should it be liable to damage by the stupidity of careless persons. A prepayment meter to successfully comply with these conditions presents many difficulties in design, especially in view of the fact that the cost of the meter must necessarily be low.

It is generally advisable to construct the case of a prepayment meter of cast iron. If sheet iron or zinc be used for this purpose, it will often be possible for unprincipled persons to so strain the meter as to obtain money therefrom. Especial care should be taken as to the receptacle in which the coins fall. If the fit of this be not accurate, or if it be flimsily made, and not fit flush against the case after being sealed or locked, the loss of money may be very considerable. It is advisable to cast, inside the front of the cash drawer, a small flanged portion of such a size that the drawer has to protrude from the meter case $\frac{1}{8}$ in. before the money is visible.

The question of accurate registration has, properly speaking, no bearing on the prepayment problem, and most manufacturers are able to satisfy this requisite. The extra retarding torque consequent on the friction of the prepayment mechanism has, however, to be taken into account, and in the case of meters having a spring device for opening the switch, the extra friction during the short time that the tripping gear is operating may be quite considerable. It does not follow that an otherwise good and accurate meter will remain so after the attachment of a prepayment mechanism.

Most prepayment meters nowadays are proof against the insertion of metal discs, coins with wire attached, and similar nefarious devices. It is improbable that these practices are the occasion of much loss to supply companies. It is, of course, impossible for prepayment meters to differentiate between metal discs of weight and size identical with those of the required coin, and such coins. The modern prepayment meter can, however, be said to have been well thought out in this particular, and leaves little yet to be done in the matter.

The consideration of proper protection for the box into which the cash is received is one which requires more careful treatment by meter manufacturers. Provision should be always made for the use of a lock for this purpose. In the opinion of the writer, seals are of little use. The class of persons who would, on leaving a house in which was a prepayment meter containing a considerable sum of money, respect a seal, would, in the majority of cases, be just as safe if there were no protective device whatever. On the other hand, people who would not hesitate to break a seal, would not care to break the case of a meter, or damage a strong lock. For similar reasons, it is important that the lock which secures the cash box also effectually secures the case of the meter on its back casting. In some prepayment meters, otherwise excellent in design, provision is made for the attachment of a lock to the cash drawer, while by breaking a seal the whole case can be lifted off or opened, and the money so extracted. It should be quite impossible to obtain money from the meter by any means short of violent damage, after the collector has locked the same. The only seal necessary will be that of the terminal plate. Many prepayment meters show this important defect of trusting to a seal to secure the cash receptacle. If this seal be found broken, a consumer will often, in the experience of the writer, protest that he will not be responsible for the safety of money belonging to the supply company so flimsily protected, will sometimes say that the wire got broken accidentally, or even deny its having been sealed at all. The use of a strong lock effectively removes this difficulty. This will, of course, in the case of the lock securing the whole case of the meter, make it impossible for the meter to be repaired, *in situ*, unless the collector be in attendance, or his key be handed over to the repair staff. An arrangement to overcome this difficulty should not be troublesome, and is well worth the extra safety.

The prepayment mechanism itself is possibly the source of most of the troubles attending the use of these meters. The various devices in use mostly fall under one of three heads: Electrolytic; those in which the weight of either a coin, or some object released by a coin, is the actuating force; and those in which the coin acts as a pawl or moving link in a device by which the switch is closed against the force of a spring. The electrolytic meters call for little comment. These are accurate and trustworthy in operation, and if well designed should give no trouble in working, except

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that common to nearly all meters of this class—that of the renewal of the electrolyte and electrodes. This objection is considered by many engineers to be so serious as to effectively preclude the use of this class of meter.

Those in which the weight of a coin or disc is the force used in closing the switch are all liable to suffer from defects due to friction. The switch in this case is of the mercury type, and this circumstance will give greater trouble in fixing. The mass of the moving part being necessarily small, this class of meter will often fail if fixed in a place where it will be subjected to vibration or shocks. If the momentum of a coin be used for the action of the switch, the chute must be carefully made or trouble will soon occur.

The remaining class of prepayment mechanisms, that in which the switch is closed against a spring, makes by far the soundest job. The spring must be of high quality and careful design, or either the extra friction at tripping, before referred to, will give trouble, or the switch will stick after some months' use. The design of this class of device rests on mechanical principles, and should, therefore, be able to be successfully accomplished.

In all meters nowadays the consumer can prepay for several coins' worth of electricity. The indicator showing the number of unconsumed coins should be of a large and plain type, so that the consumer may be encouraged to prepay more than one coin. It is neglect to use this convenience that gives rise to the complaints often heard as to the suddenness of the cessation of supply. The electricity meter is in this respect often contrasted unfavourably with the gas slot meter, which, as a rule, give at least 15 seconds warning.

The direct obviation of this difficulty has not apparently received much attention from meter manufacturers. One prepayment meter at least did partially solve the problem by the insertion of a lamp in series with the installation, instead of cutting off the supply. The complete solution is by no means easy.

Not only is a single resistance unsuitable for all loads, but the question of the payment for the current used after the prepaid electricity is consumed, and while the lights are dimmed, has to be considered. The writer is not aware that in any meter at present on the market has this problem been completely solved. Any device which would in this respect bring the electricity meter more in line with the gas meter would be of great value.

It is hoped that the above remarks, based on the experience and observation of the writer, will, in pointing out existing defects of most prepayment meters, tend to concentrate attention and stimulate zeal in the direction of their improvement and perfection.

PATENTS.

A "Four Way" and "Off" Electric Light Switch.

26899.—1909. E. Bourne, Ponders End, N. This lamp switch has eight spring contacts erected in pairs on an insulated base at right angles with each other. They are so arranged that four of the spring contacts, one of each pair, are in permanent contact with each other. An insulated spring-controlled contact piece is capable of movement between any pair of spring contacts, and is held in position by indentations shaped to receive the surface of the contact piece.

Magneto Electrical Machine.

27624.—1909. E. Turner & G. Fenwick, Trafford Park. The field magnet in this machine consists of a fixed inner pole and a fixed outer concentric pole. The induction coils, which are also stationary, are situated in the interpolar space. On moving the induction towards or away from the poles a pulsating flux is produced by which the desired electric current is obtained. A concentric cam actuates the short circuiting mechanism, so that the maximum induction period may be adjusted through 360° without affecting the strength of the currents.

Electric Propulsion of Ships.

28804.—1909. Siemens Bros. Dynamo Works & E. A. Holmes, Westminster. This is a method for driving ships, having two groups of propellers, by means of electric asynchronous induction motors and generators in which the motors of one group are driven at normal speed by generators the frequency of which differs from the frequency of the generators, which drive the remaining motors at normal speed. Means are provided whereby the normal electrical frequencies of one or more of the generators of the group having the smaller normal frequency can be halved, and the other group of generators can be rendered inoperative and the electrical connections between generators and motors can be exchanged to obtain successive stepped reduction in the speed of the ship.

Wall Plugs for Electrical Connection.

29506.—1909. A. & G. J. Bonnella, Clerkenwell. The plug connector has a radially moving spring catch on one part which enters a recess in the other part when the plug is inserted in the socket and engages laterally with it so as to prevent removal by a direct pull.

Generating Power from the Flow of Water.

582.—1910. T. Magee & S. Adair, Belfast. The apparatus for generating motive power in streams and rivers comprises a water turbine consisting of a series of spoon-shaped blades arranged on a sleeve. Two juxtaposed air-tight tanks support the turbine and direct the flow of water to it. Any form of clutch may be employed for connecting the turbine to a dynamo.

Electric Magnetic Relays.

752.—1910. G. H. Nash & Western Electric Company, London, N. On this relay the contacts are carried on stiff springs the free ends of which are inclined at an angle to their length. Screws with insulated cone points conforming to the inclined ends raise or depress the springs.

Electric Ignition Devices.

3310.—1910. Etablissements de Dion Bouton, Puteaux. A rocking arm, with a platinum point at one end, makes contact with a platinum point on the armature spindle. The other end of the arm co-operates with a stationary cam ring for the purpose of making and breaking the circuit.

Electric Furnaces.

3421.—1910. Société Anonyme Electrometalurgique, Ugine. This three-phase current furnace has two upper electrodes of different polarity and a sole electrode. Feeding is effected by two monophase transformers, the secondary terminals of which are coupled one to the lower electrodes and the other to one of the upper electrodes, with the terminals of the one inverted relatively to the terminals of the other in order to increase the tension between the two upper electrodes.

Commutator Cleaner.

4724.—1910. T. Taylor, Ardwick. The commutator and slip-ring cleaning tool consists of spring pads or brushes fitted into a flexible holder. The handle can be adjusted to any angle.

Automatic Circuit Closing Device.

9364.—1910. F. E. Bourck, Paris. This device for closing an electric circuit at a predetermined temperature consists of a mercury vessel which can be set at various angles according to the degrees of temperature of the thermometers contained in the vessel. The thermometer tubes are connected with each other so that the pressure of air above the two mercury columns is exact and permits a permanent and exact graduation of the apparatus.

High Frequency Currents.

11294.—1910. R. Goldschmid, Darmstadt. According to this method the frequency of the currents for use in wireless telegraphy is increased in successive stages by means of coils having periodically fluctuating self-induction or mutual induction.

Electric Furnaces.

11717.—1910. J. Thomson & F. A. J. Fitzgerald, Niagara Falls. The resister, which is arranged above the material to be heated, is composed of separable staggered round rods arranged between bevelled terminals. Each rod is in lineal contact with one or more of the other rods. The electric current passes through the rods in direct series.

Retarding Devices for Circuit Breakers.

12708.—1910. Electric and Ordnance Accessories Company, Ltd., & N. Collins, Birmingham. This retarding device comprises a rotatably mounted drum in the interior of which is a series of vanes. When the pull of the operating part of the circuit breaker comes upon the device, a fluid within the drum retards free rotation of the drum and also the free movement of the circuit breaker.

Electric Circuit Breakers.

13520.—1910. General Electric Company, Schenectady, U.S.A. This is an improvement in magnetic blow-outs, having abutting contacts such as are employed for rupturing the arc formed at the contacts of switches or contactors carrying a large current. The improvement consists in shaping the contacts so that the flow of current in the contacts has a directional component transverse to the arc chute.

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Electrically Operated Rock Drills.

26051.—1909. R. ROHDE, Berlin. The drill has an automatic feeding and reversing mechanism with means adapted to operate an electric switch in such manner as to stop the machine at the end of the return stroke only after the operative parts have been re-set for another feed.

Support of Electrical Conductors.

26099.—1909. T. G. NOBLE, Sacriston. The support comprises an insulator and a metal holder adapted to be sprung into engagement. The two contrivances completely embrace the cable, and as they are spring engaged they are separable by force applied to one element.

Electric Lighting of Vehicles.

26289.—1909. T. FERGUSON, Altrincham. The electric lighting system comprises a switch provided with a winding constantly connected across the terminals of the dynamo, and a magnetable core associated with such winding and with the winding of the system adapted to be alternately traversed step by step insertion of resistance into the lighting circuit is dependent upon continued movement of such core from one position to another.

Electrical Switches.

26422.—1909. H. W. COX, Nottingham. In this enclosed switch the contact arms are carried by an axle mounted in bearings inside the case. The axle is moved angularly to make and break contact. The axle has locking bolts and levers.

Commutator Bars.

26948.—1909. J. HEYS, King's Norton. The commutator bar and its lug are formed from one piece of metal. The lug operates in the usual way for making connection with the dynamo or motor.

Regulators for Dynamo Electric Machines.

27827.—1909. BRITISH THOMSON-HOUSTON COMPANY, & A. P. YOUNG, Rugby. The device consists of a movable coil which is adapted to be excited by the load current. The coil is mounted in a magnetic field, and has a movable contact member, the position of which can be adjusted so that contact may be made at any desired point in working range.

Controlling Electrical Railway Points.

2810.—1910. B. HENRARD & L. LEVEQUE, Antwerp. Rubbers or projecting parts of various lengths are arranged on the trolley to co-operate with contact strips arranged at corresponding distances from the feed conductor. The device is connected electrically with the solenoids of the points. The points are controlled without any action on the part of the staff.

Electric Switches.

5085.—1910. M. J. RAILING & C. C. GARRARD, Birmingham. This improved "knife" switch has a double acting spring, an operating bow, a saddle, and the usual contact parts. The arrangement of the device is such as to ensure a good quick break and perfect maintenance of the off position against vibration.

Automatic Telephone Exchanges.

7093.—1910. SIEMENS & HALSKE, A.G. Berlin. This is an improvement in exchanges in which a selector when once started automatically tests the lines in succession until it finds one disengaged, whereupon it connects this with the subscriber's line. A testing magnet is connected to the arm of the selector seeking a disengaged line, and the arm is placed in a local circuit in series with a resistance. This prevents the arm from becoming de-energised through disturbances or interruptions.

Igniter for Explosion Motors.

7617.—1910. L. PODSZUS, Charlottenburg. The electrode through which the air is admitted has projections and passages so arranged that a circulatory motion is given to the air issuing from the electrode.

Earthing Device for Switches.

8858.—1910. J. J. RAWLINGS, South Kensington. The metal cover of the switch when in place is the medium for connecting the metal work of the switch dolly to the earthing contact. When the cover is removed from its usual position, the metal work of the lever is no longer earthed.

Lamp Shade Support.

9547.—1910. H. A. BEARD & J. W. TOWNSEND, Banbury. This improved support is mounted on lugs upon the lamp cap, and is provided with means for preventing the shade from rattling, for lessening the liability to breakage, and for affording easy detachment.

Circuit for Resisters in Automatic Telephone Exchanges.

9634.—1910. SIEMENS & HALSKE, A.G., Berlin. This arrangement for conversation registers for automatic telephone exchanges comprises group selectors and connectors in which the register of a calling subscriber is actuated by the closing of a circuit at the connector and in which the registering electro-magnet is included in the circuit of a testing lead. The current in this lead is so adjusted as to bring about the following actions: The connection to the connector and the actuation of the register, the release of the preliminary and the testing of the lead.

Alternating Current Conductors.

9647.—1910. H. W. MALCOLM & R. APPLEYARD, Silvertown, E. In order to obtain as much loading of the conductor as desirable by the whipping method, while at the same time minimising the effective resistance due to eddy currents in the iron, the layers of iron strip are insulated from one another by alternate layers of gutta percha.

Electric Switches.

9890.—1910. CUTLER HAMMER MANUFACTURING COMPANY. Milwaukee, U.S.A. The switch has a pivoted switch arm and a pivoted latch arm. Between them is a spring which moves the latch arm to lock the switch arm in its closed position and to quickly move the switch arm to open the circuit when that arm is released.

Safety Catches for Arc Lamps.

9888.—1910. F. KOLLER, Schaumberg-Lippe. The catch comprises a pin carrying links for attachment to the load, a two-part catch free to rock on the pin, a tubular guide provided with a boss at its lower end for attachment to a support, and a tube pivotally attached to the pin and to a rope passing through the guide.

Electric Furnaces.

11716.—1910. J. THOMSON, New York, U.S.A. The resister is formed from a number of wedge-shaped elements alternately reversed and transversely displaceable with respect to each other under changes of temperature, so that any variations of pressure through the resister may be compensated for by the movement between the elements.

Electric Lamp Sockets.

13165.—1910. W. S. Ryan & L. HENGERER, New York. The socket has diagonally disposed holes in its sides for the reception of fixing means. Grooves are made for the reception of the conductors. Blades within the grooves puncture the insulation of the conductors.

Dynamo Electrical Machines.

13330.—1910. E. C. KETCHUM, Boston, U.S.A. The armature is composed of a number of discs. A brush holder co-acts with the armature so that each brush co-acts with a different disc. Each disc is also supplied with liquid lubricant by means of tubes registering with a perforated member revolving in the lubricant receptacle.

Electro-Magnetic Sparking Plugs.

13901.—1910. R. BOSCH, Stuttgart. In this plug, in which the armature moves axially against the action of a spring, the armature is so guided within the body of the plug that it can be removed when renewals are required without removing the plug from the cylinder.

Electric Signalling System.

16331.—1910. A. GOLDSTEIN, New York. This system is so constructed and arranged that upon failure of the current normally energising the system, a second and weaker source of current is automatically brought into the circuit and the resistance is also automatically adjusted to suit the weaker source.

Electric Fuses.

17047.—1910. SIEMENS SCHUCKERTWERKE, G.m.b.H., Berlin. In this screw plug fuse the means for centralising and holding the cartridge consists of a liner having a nearly conical arrangement of springs or resilent fingers. This enables cartridges of widely different diameters to be held securely.

Electro-Mechanically Operated Switch.

18443.—1910. CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee, U.S.A. This switch, which is automatically operated from a distance by means of a solenoid and provided with links to form a self-locking toggle joint which is locked by the closing movement of the switch, has a pivoted weighted lever which throws the links past their centre so that they maintain the joint in a locked position.

Electrically Driven Centrifugal Drying Machines.

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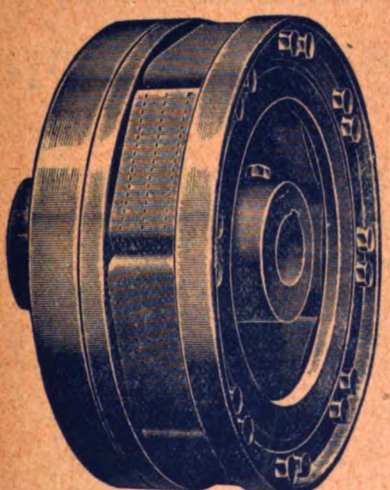

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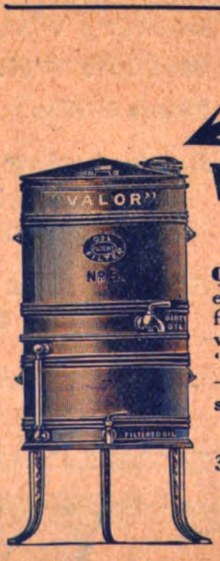

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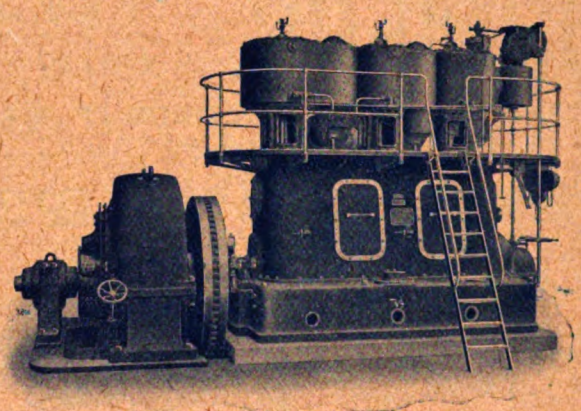

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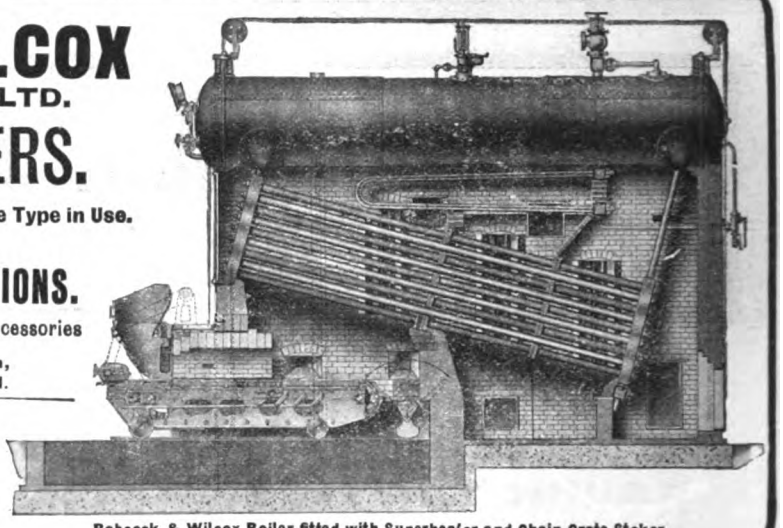

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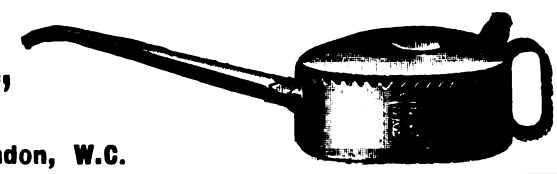

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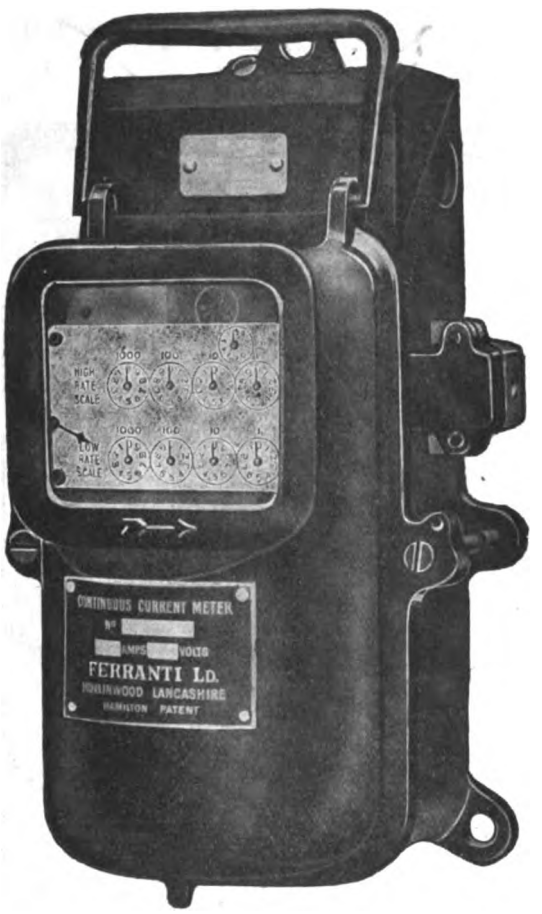

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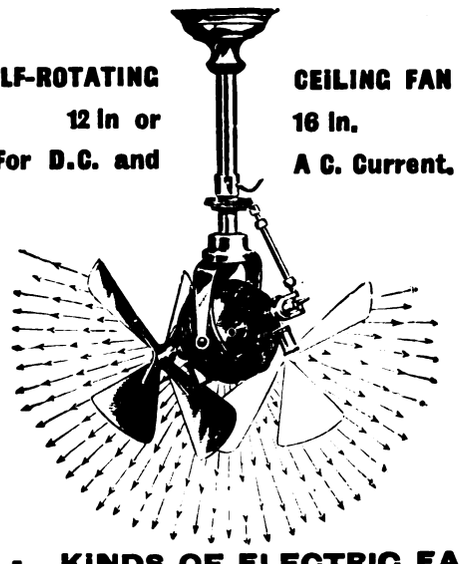

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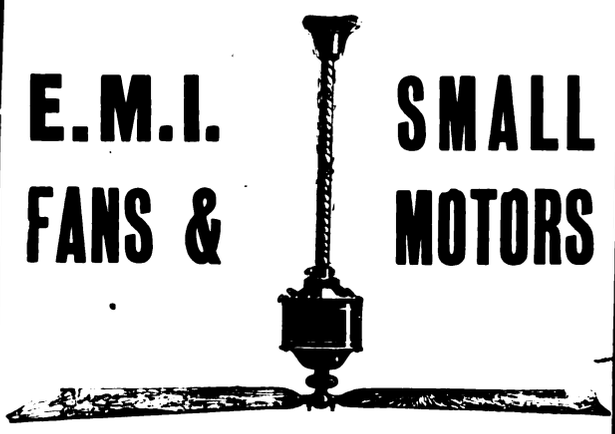

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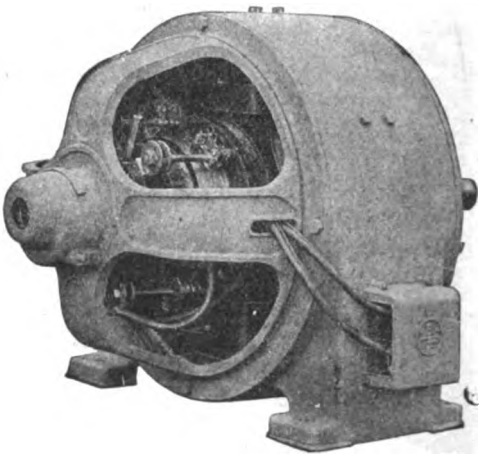

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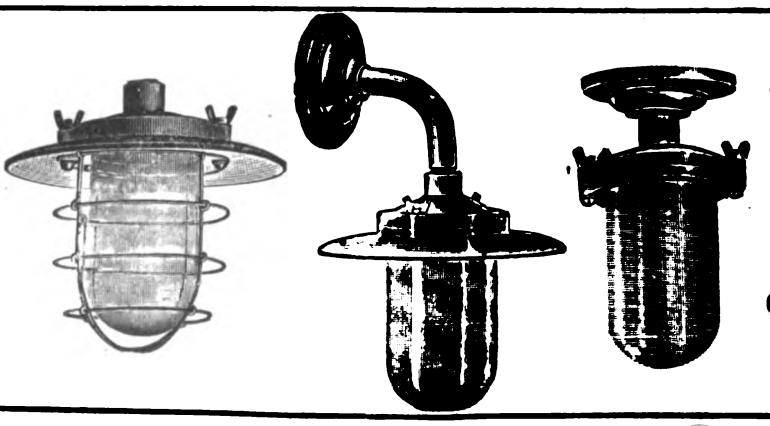

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		£	£	£	£				£						
Aberdeen Corporation	June 22	1,449	1,421	+ 27	+ 103	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940,	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+2,071	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	June 19	1,134	1,046	+ 88	+ 91	24·14	13·52	—	—	—	—	—	—	—	—
Birmingham Corporation	June 11	6,605	6,007	+ 598	—	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	—1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 782	—	—	—	—	—	—	—	—	—	—
Blackpool-Fleetwood Trams	„ 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,147	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	„ 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	June 11	5,157	4,763	+ 394	+ 131	98	54·81	„ 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	June 26	979	905	+ 74	— 444	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	June 24	6,281	5,348	+ 933	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	June 25	1,220	1,229	— 9	—	19½	19½	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	June 26	267	297	— 30	— 44	6½	6½	„ 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	„ 31	109,979	25,058,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	June 25	5,870	5,861	+ 9	+ 2,588	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,781	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6 822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	June 26	3,078	3,327	— 249	— 723	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	June 23	529	515	+ 14	+ 1,737	9·89	9·89	Dec. 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	June 3	1,772	2,034	— 262	+ 1,121	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	256	— 17	— 201	7·23	7·23	„ 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	„ 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	June 24	163	144	+ 19	+ 46	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	June 24	6,361	5,688	+ 672	+ 4,943	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	June 25	1,074	990	+ 84	+ 266	15	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	June 18	19,043	17,989	+1,054	+ 4,317	194½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·18	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	„ 31	84,704	16,200,020	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	June 25	2,786	2,497	+ 288	+ 2,025	29	26	„ 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	„ 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	June 22	140	139	+ 1	— 72	4	4	„ 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	June 22	1,452	1,295	+ 157	+ 306	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,868	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1 977	109	104	Dec. 31	572,822	124,043,239	12,231,799	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	June 19	1,412	1,420	— 8	+ 683	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	June 4	42,359	39,666	+ 2,693	+ 52,526	132½	120½	Mar. 31	1,274,660	279,166,461	25,591,028	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·36	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	+ 57	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	—2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	June 25	11,347	11,026	+ 321	+24,166	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	June 26	17,928	17,701	+ 227	+ 13,400	24½	24½	June 30	680,357	99,846,735	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	June 18	3,997	3,703	+ 294	— 1,421	60½	59½	„ 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·36
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	„ 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	„ 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	„ 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,096	4,662	— 66	— 3,826	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	June 19	6,030	5,510	+ 520	+ 4,039	39½	39	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	June 15	1,128	1,035	+ 93	+ 376	18	18	„ 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	—7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	June 15	140	120	+ 20	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,880,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	June 18	930	935	— 5	— 485	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	June 16	2,569	2,277	+ 292	+ 620	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	„ 31	44,432	9,440,369	975,714	—	10·929	2,190	6·509

a Train Miles. h Half-year's figures.

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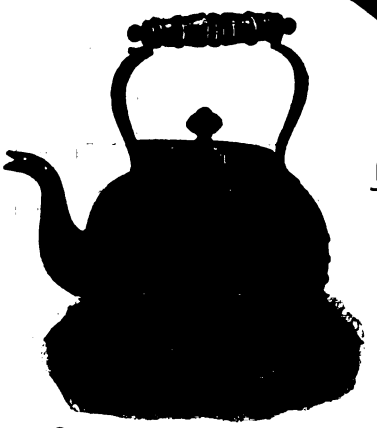

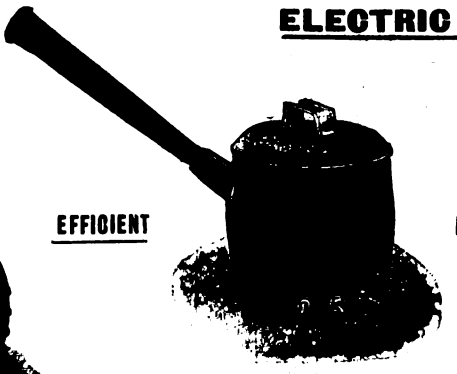

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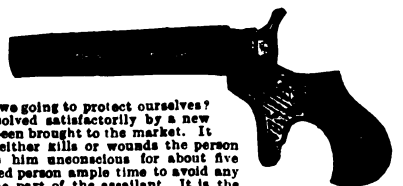

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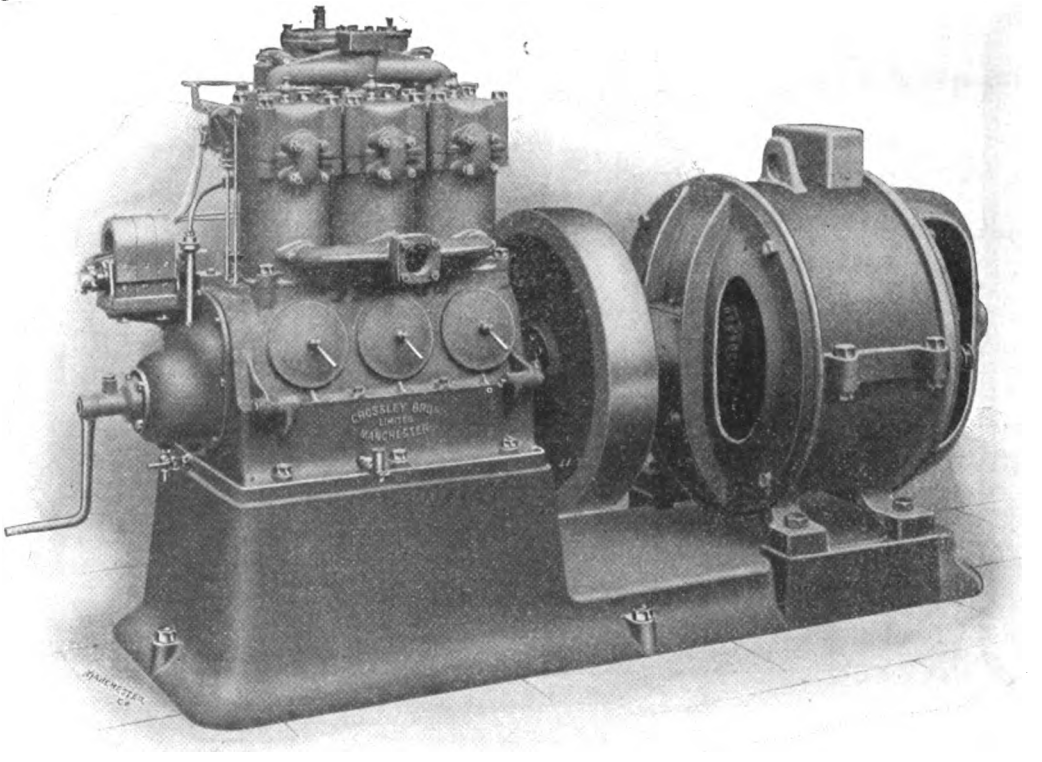

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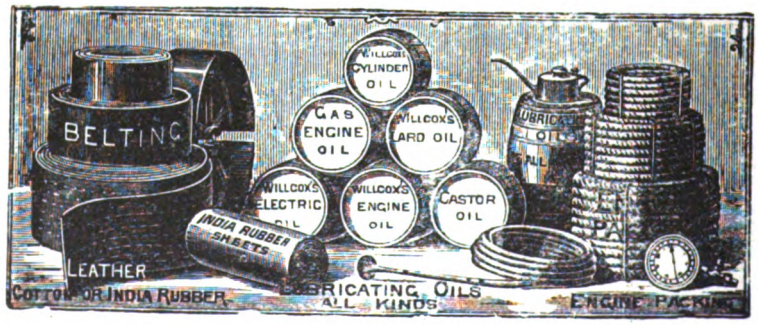

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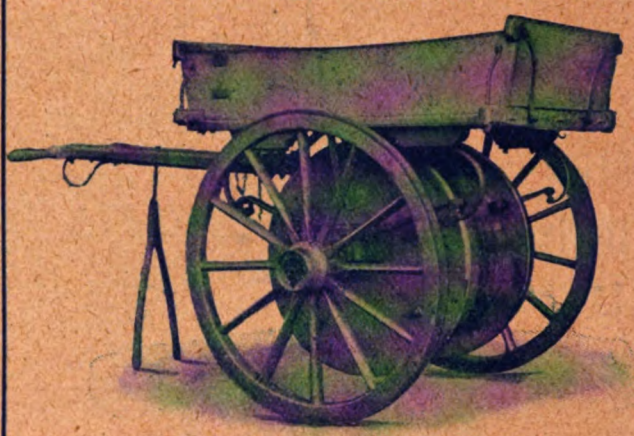

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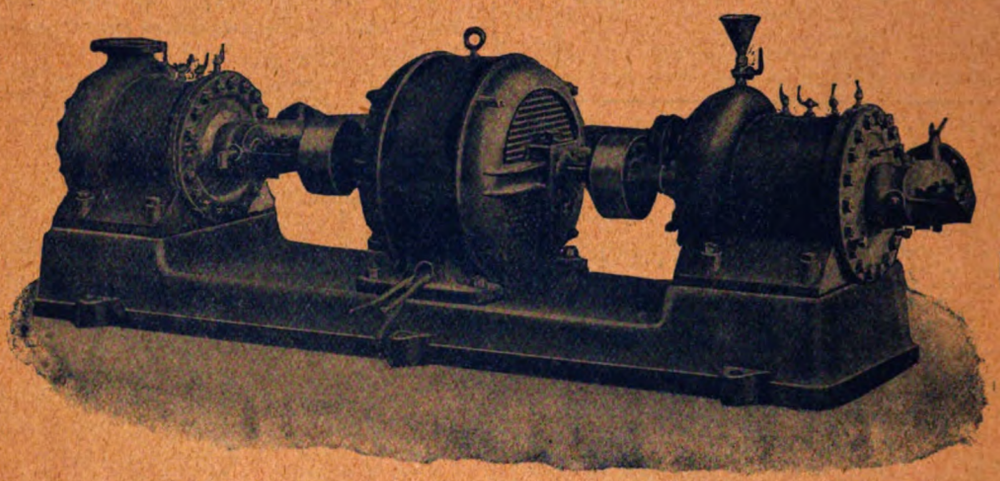

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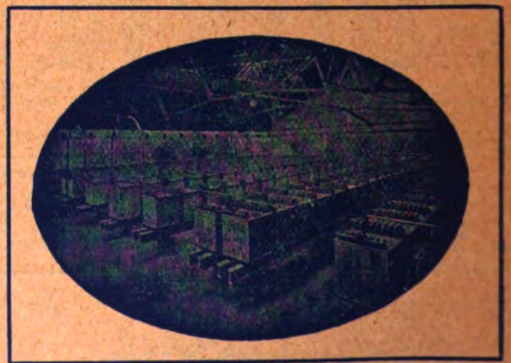

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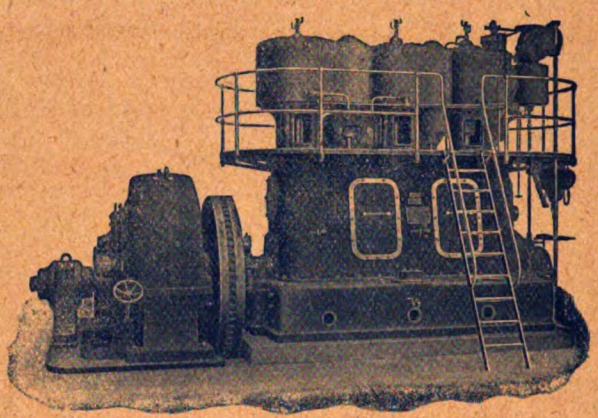

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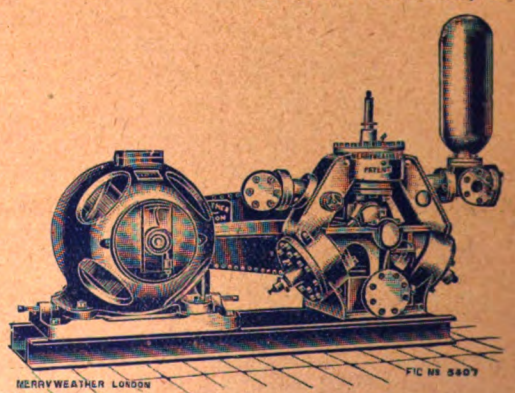

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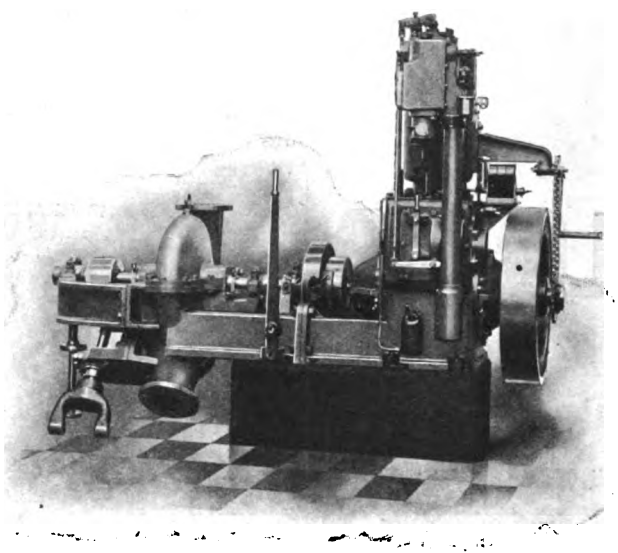

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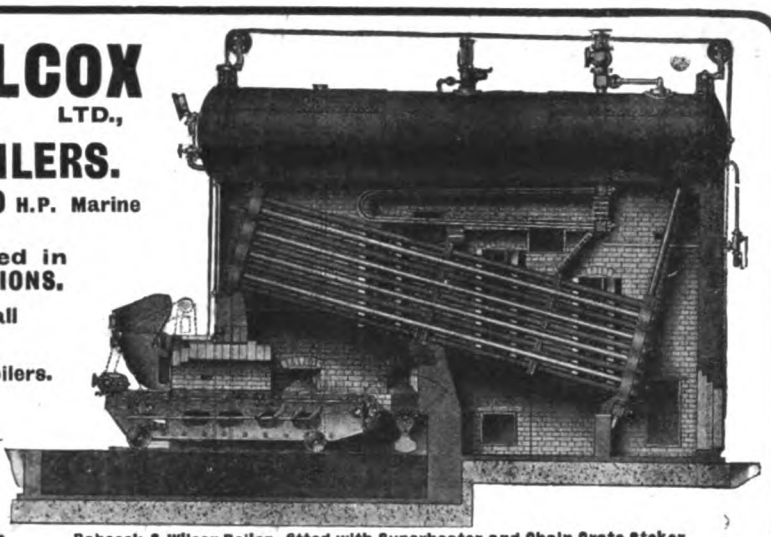

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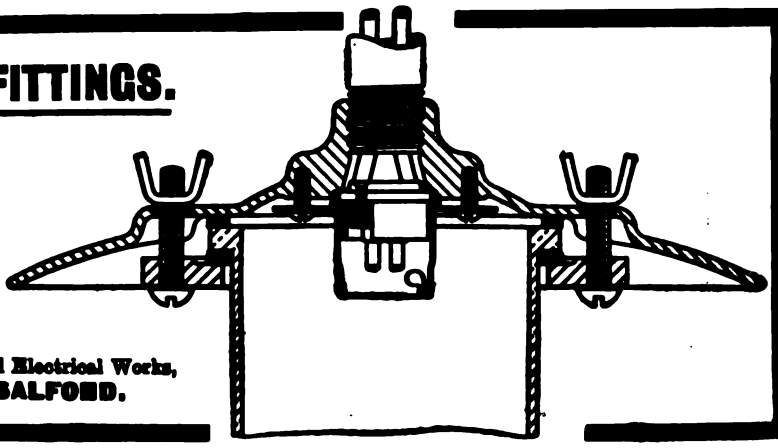

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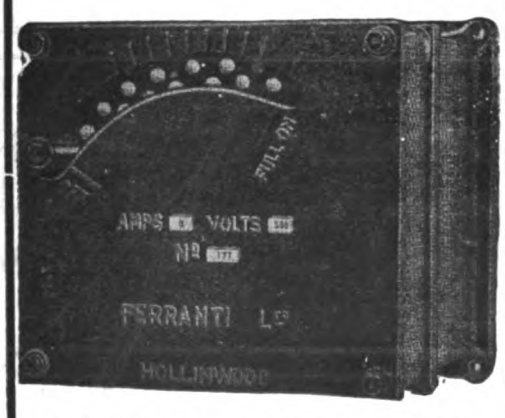

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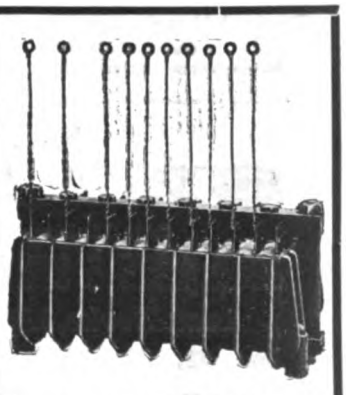

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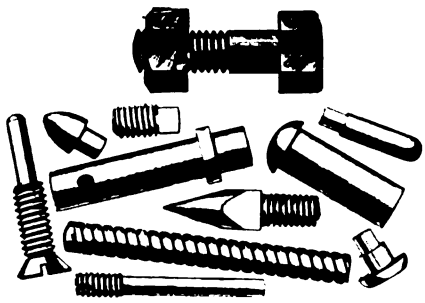

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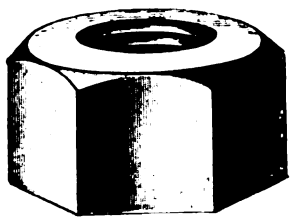

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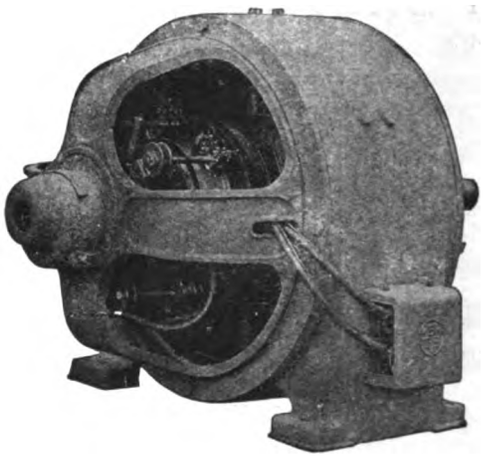

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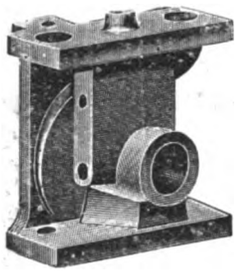

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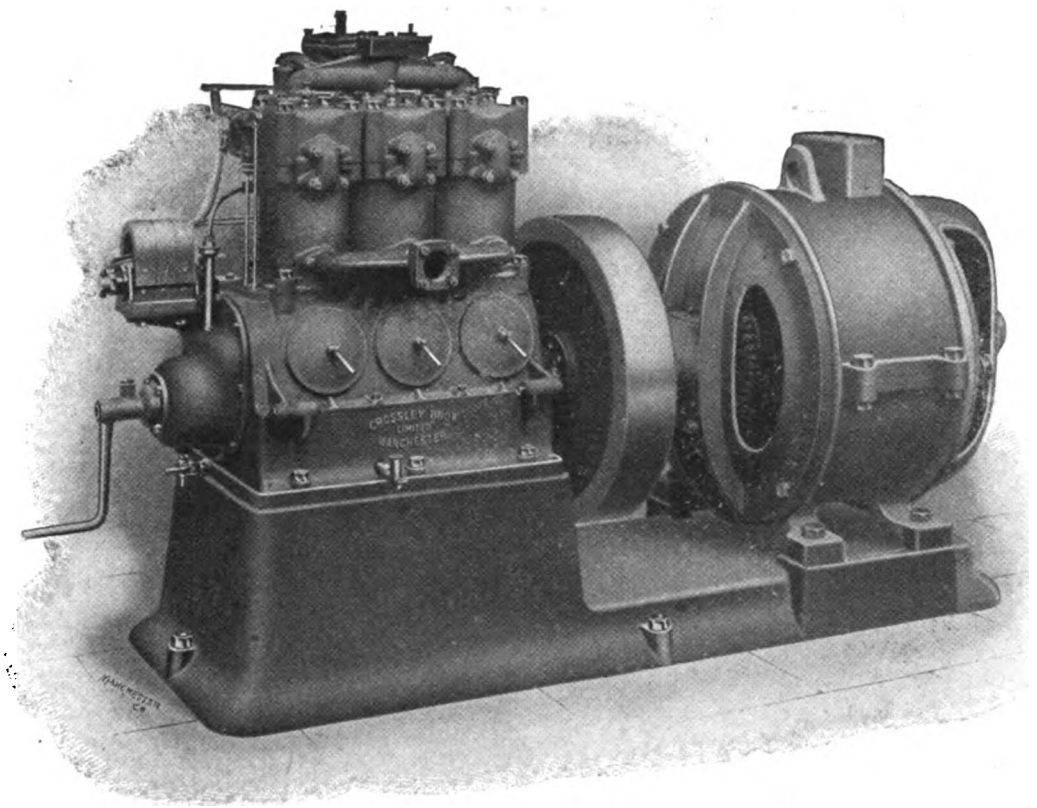

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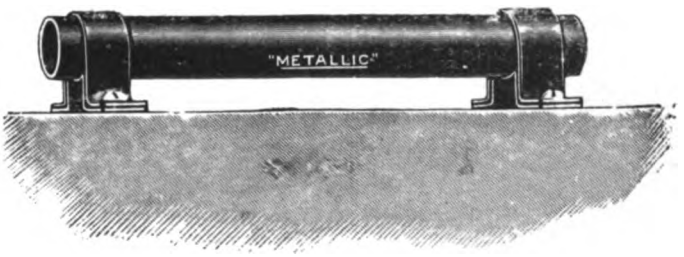

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	Ending	1909-10.	1908-9.	Week.	Current year.	1909.	1908.	Ending	Total receipts.	Passengers carried.	Car miles run.	Receipts per Passenger.	Receipts per Car mile.	Receipts per Mile of track.	
		£	£	£	£				£						
Aberdeen Corporation	Dec. 7	1,345	1,185	+ 160	+ 575	27½	27½	May 31	71,930	17,517,304	1,566,119	·98	11·02	4,940	5·93
Ayr Corporation	Sept. 18	671	562	+ 108	—	8	8	—	—	—	—	—	—	—	—
Baker Street and Waterloo Ry.	Nov.	8,141	6,070	+ 2 001	—	4·25	—	—	—	—	—	—	—	—	—
Birkenhead Corporation	Dec. 18	1,090	1,022	— 68	+ 1,036	24·089	24·089	—	—	—	—	—	—	—	—
Birmingham Corporation	Dec. 17	7,504	6,941	+ 563	+ 5,855	56·792	58·52	—	—	—	—	—	—	—	—
Blackburn Corporation	Oct. 6	1,100	1,293	— 173	— 1,036	24·53	28·3	—	—	—	—	—	—	—	—
Blackpool Corporation	Aug. 26	2,152	2,050	+ 102	+ 732	—	—	—	—	—	—	—	—	—	—
Blackpool–Fleetwood Trams	,, 8	2,304	2,309	— 24	—	—	—	—	—	—	—	—	—	—	—
Bolton Corporation	Oct. 10	2,416	2,337	+ 79	— 259	42	42	Mar. 31	117,799	25,492,902	2,492,149	1·1	11·34	2,804	6·50
Bournemouth Corporation	July 21	1,681	1,723	— 42	— 23	29½	29½	,, 31	86,225	13,991,328	1,766,068	1·47	11·71	2,912	7·22
Bradford Corporation	Nov. 19	4,640	4,425	+ 215	+ 6,781	98	54·81	,, 31	235,258	47,839,569	5,331,007	1·17	10·59	2,378	—
Brighton Corporation	Dec 18	801	702	+ 99	+ 400	9·5	—	—	—	—	—	—	—	—	—
Bristol Tramway Company	Dec. 16	5,848	5,081	+ 767	—	57	51½	Dec. 31	265,362	46,652,389	5,756,842	—	—	—	—
Burnley Corporation	Dec. 17	1,241	1,128	+ 113	—	22	20	Mar. 31	64,261	12,355,958	1,202,330	1·23	12·83	5,971	7·92
Burton Corporation	Dec. 18	281	251	+ 30	+ 271	6½	6½	,, 31	14,918	3,221,595	430,913	1·04	8·30	1,460	5·85
Cardiff Corporation	April 3	2,000	1,957	+ 43	—	—	—	,, 31	109,979	25,068,146	2,497,169	—	10·57	—	—
Carlisle Tramways Company	June 19	170	175	— 5	— 89	—	—	—	—	—	—	—	—	—	—
Central London Railway	Dec. 17	5,836	6,158	— 322	— 2,994	6·32	6·32	Dec. 31	350,150	41,898,373	1,456,780	2·01	5·769	55,404	30·27a
Charing X, Euston, & Hamp. Ry.	Nov.	6,822	6,092	+ 730	—	7·75	—	—	—	—	—	—	—	—	—
City and South London Railway	Dec. 18	3,529	3,388	+ 141	+ 695	7·26	7·26	—	—	—	—	—	—	—	—
Colchester Corporation	July 14	200	219	— 39	—	8	—	Mar. 31	10,983	2,308,721	349,539	1·09	7·74	1,477	6·56
Cork E. T. and L. Company	Dec. 22	492	467	+ 24	+ 1,871	9·89	9·89	Dec 31	24,044	5,737,478	896,945	—	6·43	—	4·43
Croydon Corporation	Dec. 9	1,548	1,509	— 39	+ 3,272	11½	—	Mar. 31	74,132	16,277,418	1,884,137	1·06	9·56	3,703	7·109
Darwen Corporation	Oct. 1	239	250	— 17	— 201	7·23	7·23	,, 31	13,899	2,557,654	245,584	1·30	13·68	1,922	9·40
Dover Corporation	Sept. 18	230	252	— 22	— 395	7	—	,, 31	11,593	2,697,672	316,754	·98	8·78	—	—
Dublin and Lucan Electric Ry.	Dec. 16	106	101	+ 5	+ 170	7	7	—	—	—	—	—	—	—	—
Dublin U.T.	Dec. 16	5,341	4,953	+ 387	+ 3,110	54½	54½	—	—	—	—	—	—	—	—
Dundee City Tramways	Oct. 6	1,332	1,305	— 27	— 569	—	26½	May 15	60,573	16,367,911	1,281,552	·875	1·9	2,371	7·46
East Ham Corporation	Dec. 17	1,066	942	+ 124	+ 1,703	14	15	Mar. 31	47,430	15,355,703	1,091,586	·73	10·26	—	6·96
Glasgow Corporation	Dec. 10	17,827	15,443	+ 2,384	+ 28,126	195½	189	May 31	907,494	226,948,290	20,766,722	·96	10·49	5,080	5·89
Gloucester Corporation	Oct. 6	395	425	— 30	+ 535	15	—	—	—	—	—	—	—	—	—
G.N., Piccadilly and Brompton	Nov.	13,429	9,354	+ 4,075	—	9·25	—	—	—	—	—	—	—	—	—
Halifax Corporation	—	—	—	—	—	52·574	37	Mar. 31	81,872	20,378,672	1,786,390	11·40	11·13	1,528	8·40
Huddersfield Corporation	Dec. 4	1,613	1,357	+ 256	+ 2,663	28	28½	,, 31	84,704	16,200,920	1,960,329	1·29	10·37	2,421	5·10
Hull Corporation	Dec 10	2,780	2,655	+ 125	+ 5,082	29	26	,, 31	128,722	30,964,254	3,022,844	1·	10·22	—	6·04
Ilford Corporation	Feb. 12	451	391	+ 60	+ 1,969	10	10½	,, 31	25,328	6,385,466	634,446	·87	9·58	2,066	6·42
Ilkeston Corporation	Dec. 21	125	112	+ 13	— 208	4	4	,, 31	7,214	1,968,850	198,415	9·1	7·9	1,803	7·04
Kirkcaldy Corporation	Sept. 8	259	266	— 7	—	7½	7½	May 15	14,993	4,874,199	459,066	·711	7·838	1,856	5·26
Lancashire United Tramways	Dec. 21	1,226	929	+ 297	— 104	39	39	Dec. 31	68,904	12,554,593	2,244,344	—	—	—	—
Leeds Corporation	Sept. 18	6,896	6,624	+ 272	+ 3,662	108	96½	Mar. 31	340,368	75,734,083	7,694,989	1·06	10·62	3,527	5·51
Leicester Corporation	Sept. 11	2,162	2,130	+ 32	—	—	—	—	—	—	—	—	—	—	—
Liverpool Corporation	Nov. 19	10,803	10,687	+ 116	— 1,977	109	104	Dec. 31	572,822	124,043,239	12,231,779	1·108	11·24	5,508	7·94
Liverpool Overhead Railway	Dec. 18	1,380	1,247	+ 133	+ 695	6·65	2·40	June 30	79,004	11,171,515	1,106,386	—	—	—	—
London County Council	Dec. 14	42,020	38,018	+ 3,337	+ 131218	134½	125½	Mar. 31	1,274,660	279,166,461	25,591,628	1·08	11·74	—	6·79
Lowestoft Corporation	Dec. 11	155	150	+ 5	+ 30	3½	—	Sept. 30	11,399	2,645,206	370,320	1·03	7·26	2,279	6·12
Maidstone Corporation	Mar. 6	157	100	—	—	7·4	—	—	—	—	—	—	—	—	—
Manchester Corporation	Sept. 11	15,631	15,297	+ 334	— 2,871	183	181	—	—	—	—	—	—	—	—
Metropolitan District Railway	Dec. 17	11,761	11,143	+ 618	+ 15,987	24	24	—	—	—	—	—	—	—	—
Metropolitan Railway	Dec. 18	18,662	18,095	+ 567	+ 12,419	24½	24½	June 30	680,357	99,846,785	—	1·46	—	—	—
Nelson Corporation	Oct. 16	151	131	+ 20	+ 7	2½	2½	Mar. 31	7,362	2,060,712	204,740	·85	8·63	1,907	—
Newcastle-on-Tyne Corporation	Dec. 17	3,941	3,685	+ 56	+ 725	60½	59½	,, 31	211,085	46,203,164	4,411,745	1·10	11·48	3,504	6·26
Newport (Mon.) Corporation	Oct. 9	663	638	+ 25	— 311	14½	14½	,, 31	35,531	8,174,003	798,029	1·04	9·89	2,450	7·21
Oldham Corporation	Jan. 24	1,778	1,516	+ 262	— 386	—	—	—	—	—	—	—	—	—	—
Portsmouth Corporation	Oct. 10	2,046	1,809	+ 237	—	28½	28½	Mar. 31	97,741	21,247,048	2,309,439	1·10	10·15	—	—
Reading Corporation	May 19	764	558	+ 206	— 5	13½	13½	,, 31	32,769	7,933,572	915,481	—	8·93	—	4·65
Rochdale Corporation	Dec. 26	1,240	1,126	+ 114	+ 746	20·9	20·93	,, 31	56,558	10,196,148	1,252,925	1·32	10·83	2,693	6·47
Rotherham Corporation	Feb. 4	555	587	— 32	—	—	—	—	—	—	—	—	—	—	—
Salford Corporation	Sept. 27	4,596	4,662	— 66	— 3,326	78	74½	Mar. 31	244,065	45,771,611	5,486,150	1·25	10·67	3,185	—
Scarborough Tramways Co.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheffield Corporation	Dec. 18	6,308	5,594	+ 713	+ 14,212	40	39½	Mar. 25	289,745	17,568,686	7,065,380	·896	9·842	4,225	5·04
Southampton Corporation	Dec. 14	1,096	950	+ 145	+ 1,187	18	18	,, 25	52,647	10,121,887	1,157,451	1·25	11·33	—	7·30
Southend-on-Sea Corporation	Aug. 21	995	557	+ 438	+ 1,483	—	—	—	—	—	—	—	—	—	—
Stockport Corporation	—	—	—	—	—	25	25	Mar. 31	52,004	9,155,172	1,335,911	1·34	9·342	1,830	4·75
Sunderland Corporation	Jan. 27	1,310	1,336	— 26	— 7,984	—	—	—	—	—	—	—	—	—	—
Swindon Corporation	Aug. 10	175	183	— 8	—	—	—	—	—	—	—	—	—	—	—
Torquay Tramways	Aug. 26	630	647	— 30	—	8·41	—	Dec. 31	15,065	2,830,420	353,297	1·40	1·023	—	—
Wallasey U.D.C.	Dec. 17	928	812	+ 115	+ 1,181	12·68	12·45	Mar. 31	43,823	8,331,038	891,540	1·2	11·79	3,453	7·72
Warrington Corporation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
West Ham Corporation	Aug. 18	2,489	2,392	— 97	+ 1,985	27	14·7	Mar. 31	122,881	35,502,836	2,556,854	·789	10·95	4,417	6·79
Wolverhampton Corporation	Nov. 3	841	823	+ 18	— 206	21½	—	,, 31	44,432	9,440,369	975,714	—	10·929	2,190	05·6

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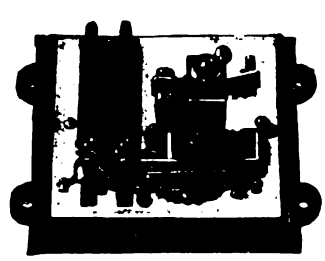
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MANUFACTURERS AND MERCHANTS.

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D.P. Battery Co., Lumford Mills, Bakewell, Derbyshire, and 11,Victoria-st.,Westminster.
Hart Accumulator Co., Marshgate-lane, Stratford.
Johnson & Phillips, Old Charlton, Kent.

Accumulator Acid Manufacturers.
Spencer, Chapman & Messel, 36, Mark-lane, London, E.C.

Acid Proof Paints.
Griffiths Bros., Mack's-road,Bermondsey,S.E.

Ammeters and Voltmeters.
The Leysner Electrical Instrument Co., 12, Lime-street, London, E.C.

Arc Lamp Hoists.
London Electric Firm, George-st., Croydon.

Auto-Transformers.
British Westinghouse Electrical and Mfg. Co., Manchester.
Brockie-Pell Arc Lamp Co.,Wimbledon, S.W.
Foster Arc Lamp and Engineering Co., Wimbledon, S.W.
Johnson & Phillips, Old Charlton, Kent.

Ball Bearings.
Fischers Ball and Bearing Co., Hinckley-st., Birmingham.
Croft & Perkins, Leeds-road, Bradford.

Batteries (Primary) and Accessories.
Ferabin Lamp and Electrical Works, 118, Queen Victoria-street, London, E.C.
General Electric Co., 71, Queen Victoria-st.
India Rubber, etc., Co., 106, Cannon-st., E.C.
Johnson & Phillips, Old Charlton, Kent.

Belting.
Willcox & Co., 36, Southwark-street, S.E.

Boilermakers.
Babcock & Wilcox, 30, Farringdon-st., E.C.
Heenan & Froude, Worcester Engineering Works, Worcester.

Cable and Wire-Covering Machinery.
Johnson & Phillips, Old Charlton, Kent.

Carbons (Arc Light).
General Electric Co., 71, Queen Victoria-street, E.C.
Johnson & Phillips, Old Charlton, Kent.
Mayer, H. G., & Co., 67, Aldersgate-street, London, E.C.
Sloan Electrical Co., Ltd., 15, Fore-street, London, E.C.

Cable and Wire Makers.
Adnil Electric Co., Ltd., Adnil Building, Artillery-lane, London, E.C.
Callender's Cable and Construction Co., Hamilton House, Victoria-embank't, E.C.
General Electric Co.,71,Queen Victoria-st,E.C.
Hooper's Telegraph and Indiarubber Works, 31, Lombard-st., E.C., & Millwall Docks.
Johnson & Phillips, Old Charlton, Kent.
London Electric Wire Co.,Playhouse-yd.,E.C.

Casings and Cleats.
General Electric Co., 71, Queen Victoria-street, E.C.

Casting Plant.
Aerators Limited, "Prana" Sparklet Works, Upper Edmonton, London, N.

Chemicals.
Spencer, Chapman & Messel, 36, Mark-lane, London, E.C.

Condensing Plant.
Allen, W. H., Son, & Co., Queen's Engineering Works, Bedford.
Belliss & Morcom, Ledsam-street Works, Birmingham.
British Westinghouse Electrical and Mfg. Co., Manchester.
Willans & Robinson, Victoria Works, Rugby.

Conduits.
Flexible Metallic Tubing Co., Ponders End, Middlesex, & 112, Queen Victoria-street.
General Electric Co., 71, Queen Victoria-st.
Metallic Seamless Tube Co., Wiggin-street, Birmingham.
New Brotherton Tube Co., Commercial-road, Wolverhampton.
Sun Electrical Co., 118-120, Charing Cross-road, W.C.

Coppersmiths.
Andrews, R. W., & Co., 148-150, Pentonville-road, London, N.
Dore, J., & Co., High-st., Bromley-by-Bow.
Harvey, G. A., &Co., Lewisham,London, S.E.

Dynamo Oil.
Willcox & Co., 36, Southwark-street, S.E.

Dynamos, Transformers, Motors, etc.
Allen, W. H., Son, & Co., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Rugby.
British Westinghouse Electrical and Mfg. Co., Manchester.
Electric Construction Co., Dashwood House, 9, New Broad-street, London, E.C.
Ferranti Limited, Hollinwood, Lancs.
General Electric Co., 71, Queen Victoria-st.
Johnson & Phillips, Old Charlton, Kent.
McClure & Whitfield, Stockport.
Morris-Hawkins, 30, St. Mary Axe, E.C.
Sandycroft Foundry Co., Chester.
Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W.
Union Electric Co., Park-street, Southwark, London, S.E.

Ebonite and Vulcanite.
F. Carson & Evans, 3a, Fenchurch-buildings, London, E.C.
Mosses & Mitchell, 69, Chiswell-street, E.C.
Traun, Dr. Heinr., & Son, 8, Redcross-street, London, E.C.

Electric Cooking Apparatus.
British Thomson-Houston Co., Rugby.
General Electric Co., 71, Queen Victoria-st.
British Prometheus Co., Ltd., Salop-street Works, Highgate, Birmingham.

Electrical Fittings and Appliances.
The Benjamin Electric, Ltd., 1a, Rosebery Avenue, London, E.C.
British Thomson-Houston Co., Rugby.
British Westinghouse Electrical and Mfg. Co., Manchester.
Dorman & Smith, Ordsal Station, Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Flexible Metallic Tubing Co., Ponders End, & 112, Queen Victoria-st., London, E.C.
General Electric Co., 71, Queen Victoria-st.
Lundberg, A. P., & Sons, Pioneer Electrical Works, 477 to 487, Liverpool-road, N.
McGeoch, Wm., & Co., 28, West Campbell-street, Glasgow.
Metallic Seamless Tube Co., Wiggin-street, Birmingham.
New Brotherton Tube Co., Commercial-road, Wolverhampton.
Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W.
Sun Electrical Co., 118 & 120, Charing Cross-road, London, W.C.

Electric Heaters.
McGeoch, Wm., & Co., 28, West Campbell-street, Glasgow.
British Prometheus Co., Ltd., Salop-street. Works, Highgate, Birmingham.

Electric Meters.
Adnil Electric Co., Ltd., Adnil Buildings, Artillery-lane, Bishopsgate-street, E.C.
The Leysner Electrical Instrument Co., 12, Lime-street, E.C.

Electric Light Contractors.
British Thomson-Houston Co., Rugby.
Ferranti Limited, Hollinwood, Lancs.
Hooper's Telegraph & Indiarubber Works, 31, Lombard-st., E.C., & Millwall Docks.
Johnson & Phillips, Old Charlton, Kent.

Electric Locomotives.
British Thomson-Houston Co., Rugby.

Elevating, Conveying Plant, Cranes, etc.
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British Westinghouse Electrical and Mfg. Co., Manchester.
Ferranti Limited, Hollinwood, Lancs.

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Belliss & Morcom, Ledsam-street Works, Birmingham.
Browett, Lindley, & Co., Patricroft, Manchester.
Crossley Bros., Ltd., Openshaw.
Petter, J. B., & Sons, 73, Queen Victoria-street, London, E.C.
Willans & Robinson, Rugby.

Engine Accessories, Tanks, etc.
Babcock & Wilcox, 30, Farringdon-st., E.C.
Croft & Perkins, Ltd., Bradford.
Dore, J., & Co., High-st., Bromley-by-Bow.
Harvey,G. A., & Co.,Lewisham,London, S.E.
Willcox & Co., 36, Southwark-street, S.E.

Engineers' Stores.
Willcox & Co., 36, Southwark-street, S.E.

Feed-Water Heaters.
Wilkinson, Geo., Beech Mount, Harrogate.

Fire Extinguishers.
The Valor Co., Ltd., Ashton Cross, B'gham.

Flexible Couplings.
Croft & Perkins, Ltd., Bradford.

Galvanisers.
Harvey,G.A., & Co., Lewisham, London, S.E.

Incandescent Lamps.
British Thomson-Houston Co., Rugby.
Cryselco Ltd., Kempston Works, Bedford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Ferabin Lamp and Electrical Works, 118, Queen Victoria-street, London, E.C.
General Electric Co., 71, Queen Victoria-st.
Henley's, W. T., Telegraph Works Co., Blomfield-street, London-wall, E.C.
Imperial Lamp Works (Brimsdown), Ltd., Kingsway House, Kingsway, W.C., Works, Brimsdown, Middlesex.
Stearn Electric Lamp Co., 47, Victoria-st., S.W.

Indiarubber Goods.
Moseley, D., & Sons, Chapel Fields Works, Ardwick, Manchester.
Willcox & Co., 36, Southwark-street, S.E.

Insulating Varnish.
Ammon, A. F., 52, Chapel-street, Blackfriars, Manchester.
Major & Co., Sculcoates, Hull.
Pinchin, Johnson & Co., Ltd., Bevis Marks, London, E.C.

Insulators and Insulating Materials.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Everitt & Co., 40, Chapel-street, Liverpool.
General Electric Co., 71, Queen Victoria-st.
Griffiths Bros., Mack's-rd., Bermondsey, S.E.
Hooper's Telegraph & Indiarubber Works,31, Lombard-street, E.C., & Millwall Docks.
Johnson & Phillips, Old Charlton, Kent.
Keys, Ltd., W. H., Hall End Works, West Bromwich.
Macintyre, J., & Co., Washington China Works, Burslem.
Mosses & Mitchell, 69, Chiswell-street, E.C.
Price, Powell, & Co., Bristol.
Traun, Dr. Heinr., & Son, 8, Redcross-street, London, E.C.

Jointing.
John Hudson & Co.'s Successors, 4, Victoria Warehouses, Mansell-street, E.
Everitt & Co., 40, Chapel-street, Liverpool.

Ladders and Steps.
Heathman, J. H., & Co., Parson's Green, S.W

Lamp Columns for Arc Lighting.
General Electric Co., 71, Queen Victoria-street, E.C.
Johnson & Phillips, Old Charlton, Kent.

Lamps: Arc & Metal Filaments.
British Thomson-Houston Co., Rugby.
British Westinghouse Electrical and Mfg. Co., Manchester.
Edison & Swan United Electric Light Co., 36 and 37, Queen-street, Cheapside, E.C.
Foster Arc Lamp and Engineering Co., Wimbledon, S.W.
General Electric Co., 71, Queen Victoria-st.
Johnson & Phillips, Old Charlton, Kent.
Union Electric Co., Park street, Southwark, London, S.E.

Lampholder Makers.
Dorman & Smith, Ordsal Station Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
General Electric Co., 71, Queen Victoria-st.

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Johnson & Phillips, Old Charlton, Kent.
London Electric Wire Co., Anchor Works, Playhouse-yard, E.C.

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Manganesite.
John Hudson & Co.'s Successors, 4, Victoria Warehouses, Mansell-street, E.

Manganese Oxide.
Everitt & Co., 40, Chapel-street, Liverpool.

Measuring Instruments—Electrical.
British Thomson-Houston Co., Rugby.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Everett, Edgcumbe & Co., 87, Victoria-st.
Evershed & Vignoles, Acton-lane, Chiswick, London, S.W.
Ferranti Limited, Hollinwood, Lancs., E.C.
General Electric Co., 71, Queen Victoria-st.
Johnson & Phillips, Old Charlton, Kent.
Nalder Bros. & Thompson, 34, Queen-st., E.C.
Schaffer & Budenberg, Whitworth-street, London-road, Manchester.

Mechanical Stokers and Conveyors.
Babcock & Wilcox, 30, Farringdon-st., E.C.

Metal Perforators—Specialty, Lead.
Harvey, G. A., & Co., Lewisham, London, S.E.

Meters.
Bastian Meter Co., Bartholomew Works, Kentish Town, N.W.
British Thomson-Houston Co., Rugby.
British Westinghouse Electrical and Mfg. Co., Manchester.

Meters—Electric.
Allen, W. H., Son & Co., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Rugby.
British Westinghouse Electrical and Mfg. Co., Manchester.
Churton, T. H., & Co., Atlas Works, Leeds.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Electromotorenwerke, Heidenau, 15, Bez, Dresden.
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Johnson & Phillips, Old Charlton, Kent.
Morris-Hawkins, 9½, Union-court, Old Broad-street, London, E.C.
Union Electric Co., Park-street, Southwark, London, S.E.

Mica.
British Mica Co., Lebanon-road Works, Wandsworth, S.W.
Taylor & Co., 40, Hatton-garden, E.C.

F. Wiggins & Sons, 102, 103 and 104, Minories, London.

Nuts, Pins, and Rivets.
Fredk. Mountford (taper pins), Birmingham.

Oilcans and Economisers.
Kaye, J., & Sons, Leeds.

Packings—Asbestos and Metallic.
Hooper's Telegraph & Indiarubber Works, 31, Lombard-street, E.C., & Millwall Docks.
United States Metallic Packing Co., Soho Works, Bradford.
Willcox & Co., 36, Southwark-street, S.E.

Platinum Utensils.
Derby & Co., 44, Clerkenwell-road, E.C.

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Johnson & Phillips, Old Charlton, Kent.

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Croft & Perkins, Leeds-road, Bradford.

Pumps.
Merryweather & Sons, Fire Engine Works, Greenwich, S.E.

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Adams' Mfg. Co., Ltd., 106, New Bond-st., London, and Bedford.
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Ferranti Limited, Hollinwood, Lancs.

Silk and Lace Shades.
Taylor & Co., 40, Hatton-garden, E.C.

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Dorman & Smith, Ordsal Electrical Works, Salford.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.

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Auto Controller & Switch Co. (Fluxite), 70, Vienna-road, Bermondsey, London.

Stampings and Metal Perforators.
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General Electric Co., 71, Queen Victoria-st.
Johnson & Phillips, Old Charlton, Kent.
Lundberg, A. P., & Sons, Pioneer Electrical Works, 477 to 487, Liverpool-road, N.
McGeoch, Wm., & Co., 28, West Campbell-street, Glasgow.
Sun Electrical Co., 118 & 120, Charing Cross-road, London, W.C.

Tachometers.
Lunken Valve Co., 35, Great Dover-st., E.C.

Telephones.
General Electric Co., 71, Queen Victoria-st.

Testing.
Faraday House, 62-70, Southampton-road, London, W.C.

Tools.
Youngs, Ryland-street Works, Birmingham.

Tramway Equipments.
British Thomson-Houston Co., Rugby.
Ferranti Limited, Hollinwood, Lancs.

Turbines.
British Thomson-Houston Co., Rugby.
Willans & Robinson, Victoria Works, Rugby.

Ventilating Fans.
British Thomson-Houston Co., Rugby.
Capell Fan Co., 13, Mosley-st., Newcastle-on-Tyne.
Edison & Swan United Electric Light Co., 36 & 37, Queen-street, Cheapside, E.C.
Gibbs, J., & Son, 72, Duke-street, Liverpool.
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Matthews & Yates, Cyclone Works, Swinton, Manchester.

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Ammon, A. F., 52, Chapel-street, Blackfriars, Manchester.

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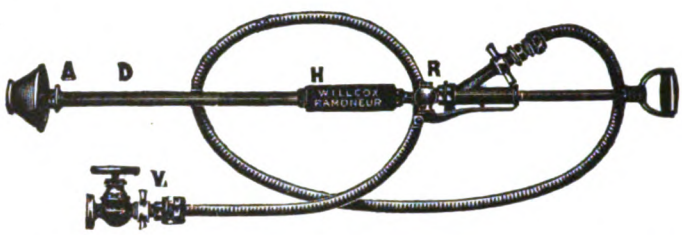

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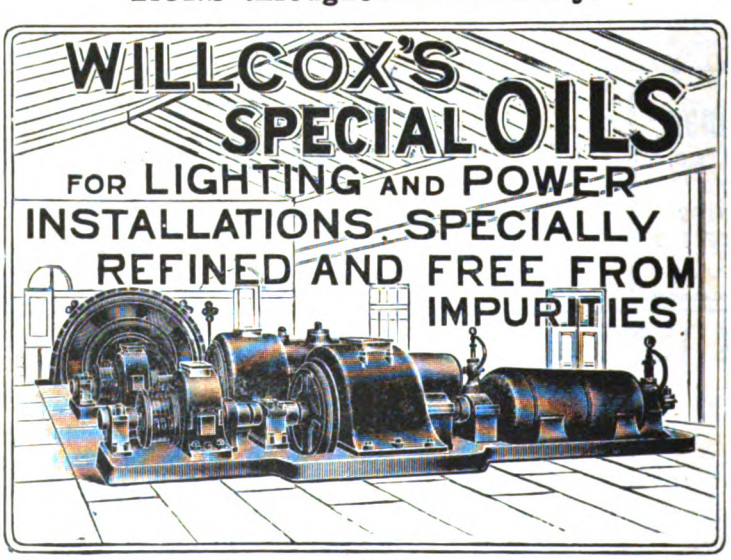

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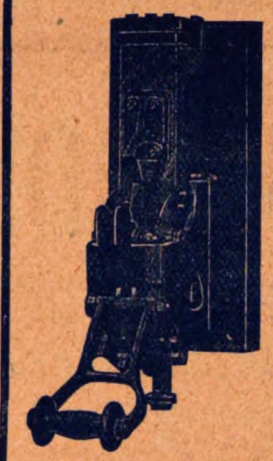

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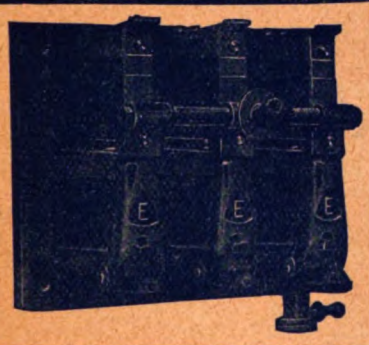
Warstone Lane,
BIRMINGHAM.



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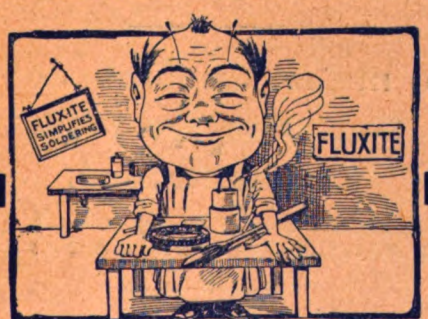

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